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ELEMENTARY LESSONS

ON

Vol 27-P

SILVER PRINTING

BY

W. M. ASHMAN.

Revised, and Reprinted from the PHOTOGRAPHIC NEWS,

WITH ADDITIONS TO DATE.

LONDON:
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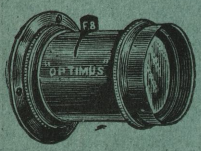

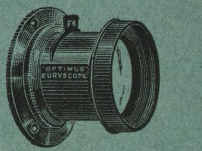

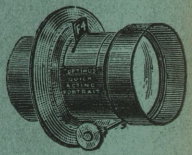

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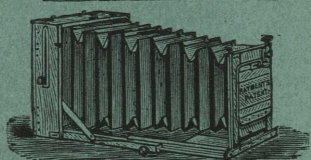

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PREFACE.

THIS small brochure, which now takes a place among the candidates for public favour in this country, can scarcely be said to be quite new.

Originally the chapters herein contained were, in great part, embodied in a series of Elementary Lessons in Silver Printing, written for the pages of the PHOTOGRAPHIC NEWS, some time ago. Since the publication of those articles, the subject matter has appeared in the body of foreign journals. It has also been reprinted in book form, and already more than one edition has been distributed. Owing to the favour with which it has been received, the Author, perhaps somewhat hastily, concluded that the work had proved useful, and, acting upon that assumption, he has revised the original articles throughout, and made certain additions thereto, in order to bring the book up to date. Only matter which can well be dispensed with has been omitted, and its place occupied with more complete instructions for preparing and using ready sensitized paper. No attempt has in the present instance been made to include other printing-out processes, such as that of silver chloride in gelatine, neither have development processes like Platinotype, Carbon, or Silver Bromide, been introduced; but should the present work meet with sufficient support to justify the printing of further editions, some at least of the processes named will be incorporated.

SILVER PRINTING.

CHAPTER I.

As long as chloride of silver in conjunction with albumen remains to be the favourite printing surface employed by photographers for small work, so long may it be with fairness anticipated that reliable instruction will be sought after by tyros in the art, who, from a limited knowledge of the subject, and the possession of that most laudable desire to excel, are unconsciously impelled onwards towards attaining the highest degree of perfection the process is capable of. As an aid to the achievement of success these pages are written. In the following chapters the intention aimed at is to describe each process separately, and in such a manner that beginners, whether amateur or professional, may, by paying strict attention thereto, be enabled to produce good results. Doubtless the experienced photographer will not find anything herein contained that he is not already acquainted with, still it may not prove to be an altogether unprofitable occupation should he be led to peruse this little book in his leisure moments; for it should be remarked that in compiling this elementary treatise on silver printing, care has been taken to include formulæ of high standard excellence, as well as such practical hints as have been acquired by long association with this special branch of photography.

Before entering into details of manipulation, it is perhaps preferable to deal with the matter of fittings.

In the first place we will devote a little space to the consideration of the "printing-room."

The locale of the printing-room will, in the majority of cases, be subjected to general arrangements of the building, and the amount of work that will probably be required. In arge establishments, where a vast number of prints are daily produced, separate apartments are reserved for each operation; but if a limited quantity only is demanded, one room may with care be made to do the duty. In this latter case the position chosen should by preference be situated on or near the ground floor, where the most equable temperature can be secured, and within easy access to the garden or other open space, which should offer an outlook of sky unobstructed by high buildings, and where a practically unlimited amount of light can be depended upon. The paper on which silver prints are made may be purchased already sensitive to light, but the details of production will be dealt with as we proceed. If the reader determines to sensitise paper for use as required, he will find it advisable to have a supply of water, a sink, and waste tub fitted up in the printing-room, in order that vessels, after use with silver nitrate solution, employed in sensitising, may be cleansed. Unless this is done effectually, many failures from scum markings will occur, besides loss from non-recovery of the silver. Should the contrary be the case, and the convenience offered by ready-sensitised paper be chosen, the question of water supply will also need to be considered if the printing room has to be used for washing the prints, and other processes they undergo, as we shall presently see. Having decided, then, upon the position of the room, the next step is to fit it up in a suitable manner for working. This need not involve a large outlay, and those who are handy with tools will probably prefer making the necessary alterations themselves

rather than wait about for the local mechanic. In order to show the requirements of a work table in the printing room,

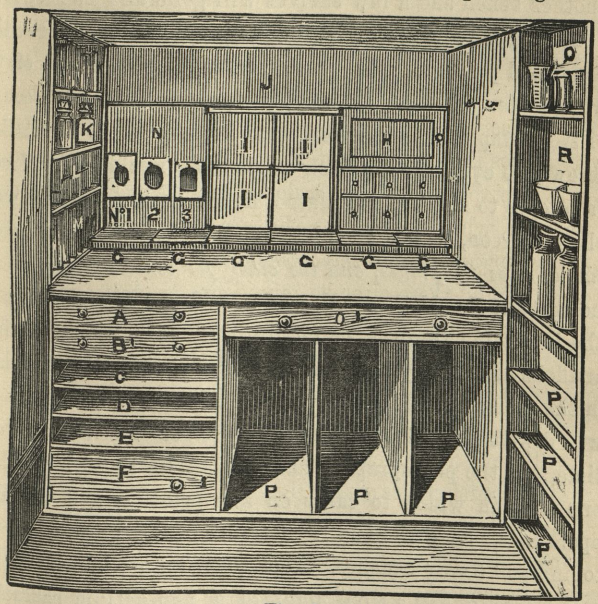

Fig. 1.

The drawer marked A is intended for albumenized paper, unsensitized; it should fit well, in order to exclude dust.

B, tinted paper, cardboard, papier minerale, and masks, for vignetting.

C, receptacle for sensitizing dish. D, toning dish. E, hyposulphite of soda tray.

F, store cupboard for cuttings of sensitized paper, waste prints, blotting pads and filtering paper, impregnated with silver nitrate; when kept clean the task of reducing is less tedious to the refiner, and more profitable to the photographer.

G G G G G G, a series of boxes with hinged lids for storing sensitive paper cut to size before printing, thereby preventing any darkening action from the light in the room. Prints after removed from the negative may also be protected from light in these boxes, until sufficient have been got ready for toning.

H, nests for negatives out of print.

I I I I, window protected by one thickness of golden fabric on spring roller. A northern aspect is preferable.

J K L M P, shelves for negatives, printing frames, bottles, &c.

N, space for oval, dome, and other shape masks, for blocking out portions of negatives when printed. These should be arranged in sizes, and may for convenience be hung on nails; a piece of sheet lead placed on the outside will keep them flat.

O, drawer for dusters, cutting shapes, diamond, trimming knives, scissors, &c.

Q, shelf for graduates.

R, arrangement for supporting funnels, whereby the chances of bottle or funnel and its contents being capsized is avoided.

the foregoing sketch has been made (fig. 1). The scale of measurement is half an inch to the foot. Besides this, another bench and a few shelves will generally be needed.

The space requisite for drying accommodation of sensitive paper and prints may be provided for at either end of the work table. The easiest way, perhaps, is to insert a couple of stout staples into the wall opposite, say to K L M, then screw two eyes into the back of shelf K, run a piece of cord from eyes to staples, and place a dozen or so American wood clips thereon, which completes the arrangement. *Use one line of clips for prints, and the other for sensitised paper.* On no account should these clips be mixed up, or stains will be the inevitable result. To facilitate the operation of drying, artificial means may be resorted to, and if there is no fireplace in the room, a small gas or paraffin oil stove, burning below, will distribute sufficient heat to dry paper or prints in a short time. If the photographer has decided to limit himself to one room in which to carry on his printing and finishing operations, he can himself determine the position of his toning and fixing benches. Due regard must be paid to the water supply, and a front light of a non-actinic character, similar to that shown in the sketch, should be provided. Enamelled iron troughs and dishes are, when properly made, eminently suitable for washing and fixing prints. They are easily cleaned with a little common salt, not liable to fracture, and the moderate cost renders their use extremely economical. It is a good plan to fit such into the woodwork of a bench, so that heat may be applied from below to increase the temperature of the solution whenever necessary. If the troughs are fitted with plugs the solutions may be conveyed away in pipes, and when the whole surface

is covered with suitable lids a useful bench for supporting flat trays, printing frames, &c., is formed. An efficient means of saving residues ought also to be provided; for according to very good authority, the amount recoverable of the precious metals used has been variously estimated from fifty to ninety per cent. Few practitioners, however, claim to do the work so thoroughly as to reach the higher estimate, but with ordinary care enough silver can be prevented from escaping to make an appreciable item in a year's work. This subject will be further considered in Chapter XII. In a printing room such as herein described the work carried on will be briefly as follows:—Sensitising the paper, drying ditto, cutting to requisite sizes, adjusting negatives and fixing masks thereon in printing frames, securing a piece of sensitive paper therein ready for transference to strong light to be printed, replacing with fresh paper when the first is printed sufficiently dark, cutting prints, washing the soluble nitrates and unacted upon silver free from the print, changing the colour of the image in chloride of gold solution (known as toning), again washing, then dissolving any excess of silver and gold chloride remaining by means of hyposulphite of soda, which process is termed fixing. Copious washing to remove all traces of the fixing salt follows, after which the prints may be suspended from the clips, already referred to, until dry. Although mention has been made of the toning and fixing processes being carried on in the same apartment as that of sensitising, it is only with extreme caution that the work can satisfactorily be performed; and it should be distinctly understood that we are not only unfavourable to working in this manner, but strongly urge all who can manage to do so to provide sepa-

rate accommodation for toning and fixing. Especially the latter process needs isolating, for the reason that when once a floor or table becomes saturated with the fixing solution, either by spilling small quantities, or allowing it to drop about, it is of such a penetrating and destructive character that hardly anything appears to withstand its action for a lengthened period of time. Wood and stone, cement and bricks, alike perish when subjected to its influence. These materials, after becoming charged with the salt, yield an abundant supply of a crystalline substance which is liable to be a serious cause of trouble to the silver printer, since particles floating in the atmosphere may at any time settle upon the prints or derange the solutions. In the former case, spots more or less irregular in outline become developed; in the latter, streaks, yellowness, and difficulty in obtaining brilliancy, are the chief faults.

CHAPTER II.

ALBUMENIZED PAPER.

Ordinary photographs are usually printed upon one of three makes of paper—"Saxe," "Rive," and "New Rive." The Saxe paper is obtained from a mill at Malmedy, in Saxony, and is distinguished by bearing the brand of the manufacturers. It was formerly a coarse-grained and tougher paper than the Rive, and has been recommended for large prints, as it is supposed by some to be more strongly-sized, and therefore better able to withstand the washing ordeal through which prints have to be subjected.

The Rive paper takes its name from a small town so named, situated in the south-east of France, and may b distinguished by the water mark "Rive," &c. The sheets, as issued by albumenisers, are just a trifle smaller than the Saxe. It is manufactured from the best white rags, and every care is taken to avoid mineral impurities entering into the composition of the pulp throughout the various stages of the process. The paper is made on bands about five feet in width, and of great length; so that the dimension now regarded as a full-size sheet of paper (slightly under 23 by 18 inches) is by no means the limit to which silver prints need necessarily be restricted. Wholesale dealers are now enabled to have a special water mark brand in a batch of paper if they so desire it. Rive paper is often said to be very

suitable for small work, giving better tones, and possessing finer texture than others; but these assertions can hardly be regarded as facts at the present day, since those who conduct the mills are continually improving their plant, with the result that paper to suit all photographic purposes may be obtained from either mill.

New Rive is very similar in its characteristics to Rive, and is understood to possess a slight advantage as regards cost. It is not so well known in this country as upon the Continent.

Nearly the whole of the photographic paper used throughout the universe emanates from these mills, and usually bears a water mark signifying the mill from which it is issued, as Saxe, B. F. K. Rive, or Renât Rive. These papers are sent out in ten ream cases, and upwards, of sheets untrimmed, measuring about 23 by 18 inches. They are sized in the process of manufacture, and ready for albumenising, which latter operation is carried on extensively in this country, and in Germany. Each albumeniser has his own pet formula, and some degree of secrecy is observed by them all. The mixture given on next page is a fair specimen of those in daily use, and with care will yield most excellent results. To render paper suitable for printing is the next thing which requires explanation, and in so doing the details of albumenising will transpire.

If we take a piece of plain Saxe or other paper, and expose to sunlight, no change is seen to take place, neither would there be a strongly-marked action had the paper been previously dipped in silver nitrate solution. But suppose another piece of the paper be soaked in a solution of common salt, and dried, then upon contact with silver nitrate solu-

tion a sensitive salt would be formed upon the surface, and when dry would rapidly darken in sunlight. Plain salted paper prints are practically prepared in this manner, as we shall see in Chapter IV. The dull surface, however, though useful for the purposes of painting upon, is not in favour for the production of ordinary photographs. A glazed surface is desired, and this is produced with a coating of albumen. The paper is laid upon a solution of albumen, containing any chloride salt or mixture thereof chosen to form silver chloride when the actual sensitising bath takes place. Although it is not expected that a beginner will prepare his own paper, it is necessary he should be familiar with its preparation. To every gallon of fresh albumen, *free from yelk or germ*,* add the following mixture:—

Ammonium chloride	2 ounces
Barium chloride	½ ounce
Glacial acetic acid	2 ounces
Soft water previously boiled	6 ounces

When dissolved, add gradually to the albumen, and if it is intended to stain the albumen coating deep blue, mauve, pink, or other tint, a solution of the dye chosen should be added at the same time. The whole is then to be whisked to a froth, then put away in a cool place for twenty-four hours at least, for the froth to subside. The mixture, after being strained through fine cambric, is ready for use.

Coating is performed by floating the smoothest side of the paper on the liquid, where it should remain thirty to forty seconds, but not longer. Upon removal it is dried in the manner hereinafter stated. The room intended for

* Unless care is taken to exclude both yelk and germ, streaks of albumen and animal membrane will appear on some of the paper.

albumenising should not be used for any other purpose, and the following fittings are requisite:—One or more level benches to support flat, shallow dishes 26 by 20 inches, containing filtered albumen; a V-shape trough, extending the length of benches, to catch excess that drips from sheets; a stove that gives very little dust, at the same time emitting great heat (an ordinary ironing stove fixed in the middle of the room answers well); cords stretched across the room, whereon to finish drying the sheets; two upright one-inch planks with three-quarter inch holes, some of which are bored level, and others at a slight angle; several wooden rods 26 inches in length, and of the diameter to fit the holes bored in the planks; a whisking bench and some glazed earthenware pans complete the apparatus. The filtered albumen is poured carefully into flat dishes previously dusted, the formation of air-bells being avoided, and upon this the smooth side of the paper is brought in contact in such a way that bubbles are not formed. There are three ways of doing this—first, by holding the opposite corners diagonally in each hand (Fig. 2), allowing the sheet to fall in

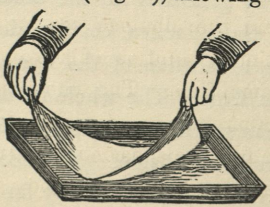

Fig. 2.

a convex form gradually on the surface of the solution, first the centre, and lastly the corners which have been held. The second plan is that of lowering one corner first, and steadily dropping the other portion without stopping. If a

halt is made it will produce a line when printed more vigorous than the rest of the print. The third and much to be preferred method is that of placing the extreme edge of a sheet held lengthwise upon the solution; that is to say, the side measuring about 23 inches between the two hands; then with a quick and even motion carry the edge over the surface of the liquid, when the whole of the sheet will be in contact with the albumen. Particles of dust which may have fallen on the liquid will thus be carried to the opposite side. In either case, if the sheet has been properly coated, it may be slowly withdrawn at the expiration of thirty or forty seconds, and laid, albumenised side outwards, over one of the wooden rods. One end of the rod should be inserted in the plank, when it will be found that the slight angle produced by the holes not being bored straight is sufficient to cause the excess of albumen to run off at the two lower corners into the V-shaped trough, and no danger need be apprehended of the sheet drying unevenly or slipping off. A stock of rods should be always at hand, so that the paper need not be removed until nearly dry. During the period of floating and drying, the temperature must be kept up to at least 80° F., or a good surface is not obtained, low temperature being conducive to dullness. Drying at a higher temperature, say 100° F., a brilliant surface results, but the paper is very liable to blister in the after processes. Care should be taken to exclude draught and other causes likely to produce dust, as any particle settling upon the paper during drying will be sure to remain. When the paper is nearly dry it is removed from the rods and spread on cords already referred to. When quite dry the sheets are piled in heaps, albumenised side downwards, and conveyed to a room set aside for packing.

Here, by the application of pressure slowly increased, the paper is again made to lie perfectly flat, when the edges are trimmed, and it is ready for the market. Paper which has been stocked a month or two after preparation works better than when quite fresh. Old albumenised paper gives motley markings and other spots; the whites of the resulting print, moreover, are rarely pure. The quantity of albumen required to coat a ream of paper once, weighing ten kilograms, averages about two gallons. Doubly albumenised paper is treated similarly to the foregoing, but the first coating is coagulated by means of steam; it is afterwards re-floated and dried as above.

Very few photographers albumenise the paper they use, most probably on account of the difficulties arising from the dust, and peculiarities in some samples of plain paper, which only an experienced eye can detect. Those unacquainted with the characteristics referred to would fail to obtain a satisfactory paper, however rich the albumen coating may be, and as albumenised paper is a commercial article which can be bought possessing excellent qualities, there is no reason why photographers should attempt its preparation.

CHAPTER III.

SENSITIZING.

When a piece of albumenized paper, prepared as directed in the last chapter, is placed in daylight, it remains unaltered, for the reason that the chloride salts therein contained are insensitive to the influence of light. If we immerse or float the paper on a solution of nitrate of silver, a chemical change will take place in the composition of the salt contained in the paper. The ammonium and barium chloride will lose their chlorine; the silver, having a greater affinity for chlorine than either the ammonium or barium, will attract all the chlorine to itself in preference to the nitric acid previously in combination with it; we shall, therefore, have a compound of silver formed called silver chloride, together with an organic compound—albumenate of silver. In this reaction, nitric acid is disengaged from the silver nitrate, and is free to combine with ammonium and barium. These nitrates being more or less energising agents, we need only follow the silver salts which darken in the light. Float a piece of albumenized paper on a solution of nitrate of silver, performing the operation in a yellow or orange-coloured light. No apparent difference will have taken place in the paper.

Expose a portion of it to daylight, leaving a part of it covered with some opaque substance: the exposed portion will gradually turn grey, then purple, afterwards deeper, until finally it reaches a dark copper colour of bronzed hue, beyond which no further change is seen to take place. Now what has happened? The action of the light has changed the chloride of silver into a sub-chloride, and liberated chlorine gas, which can be collected if the experiment is performed under water.

Silver sub-chloride consists of two equations of silver and one of chlorine. Previous to exposure, the compound may be said to represent $2AgCl$; after exposure, it would represent Ag_2Cl+Cl. As a matter of fact, organic compounds and free nitrate of silver are always present besides, so that, in practice, chlorine does not actually escape. Many additions have been recommended for the sensitizing bath, such as the nitrates of ammonia, lead, potash, and soda; methylated spirits of wine, camphor, common alum, sugar, &c., also converting it into ammonia nitrate of silver; but no very distinct advantage appears to have been gained thereby over that of a plain neutral silver nitrate solution. These will be referred to in the following chapter. The proportion of nitrate of silver per ounce of solution may vary from 35 to 60 grains; beyond these limits it will not be at all necessary to go.

Supposing that the paper has been prepared with albumen in which has been dissolved six grains of a soluble chloride per fluid ounce. We should make up the sensitizing bath at least five or six times that strength—say 40 grains of silver nitrate per fluid ounce of water. Half a gallon of this solution would give us a bath on which half a quire of paper

could be sensitized; it would then be necessary to replenish with more silver nitrate. Should, however, the albumenized paper contain ten or twelve grains of chloride per fluid ounce of albumen, the strength of the sensitizing solution would require to be proportionately stronger—say from 50 to 60 grains of silver nitrate per fluid ounce.

The character of negatives to be printed ought to be taken into consideration in determining the strength of the sensitizing bath. A properly exposed and vigorous negative will yield a bright print on paper that has been sensitized on a 35-grain silver nitrate solution; an indifferent negative may require the strength to be 60 grains. Negatives which are very dense in parts, and also possess large masses of shadows, are difficult to print satisfactorily, even with the silver bath as low in strength as 30 grains to the ounce, for the reason that the energising agents above mentioned cause too great contrast by assisting in the reduction by light of a disproportionate amount of silver albumenate and other organic bodies which may be present. To overcome the difficulty, then, with negatives of this class, the time of floating should be reduced, and, in extreme cases, excellent prints may be obtained on washed paper—that is to say, after the paper has been floated for a short time on a medium strength bath, it is dried, washed from three to five minutes in distilled water, again dried, and then printed.

Sensitizing Bath for Ordinary Work.—Make up the following solution:—

Re-crystallized nitrate of silver	...	...	...	8 ounces
Soft water ...	...	...	...	80 ,,

When dissolved, filter through Swedish filtering paper or a piece of clean sponge pressed tightly into the neck of the

funnel; this solution is named sensitizing or exciting bath. Test the solution for acidity by placing in it a piece of litmus paper. Should the colour of the paper change from blue and become slightly reddish, it indicates that free nitric acid is present, which should be neutralized by means of sodic carbonate. A good plan is to have two bottles for the bath: one for pouring into when sensitizing is finished, in which a little sodic carbonate is always kept to insure the bath being neutral; and the other bottle should be used for filtering into (see R, fig. 1, page 3). The above quantity of solution will be found enough to float whole sheets of paper, and sufficiently strong to coagulate the albumen perfectly.

When the proportion of silver is much below 30 grains per ounce, and neutral or slightly alkaline, there is a tendency for the albumen coating to leave the paper, since dilute silver solution does not coagulate albumen perfectly. This may be known by the appearance of dull lines and patches upon the surface of the paper as it leaves the sensitizing bath; also when an opalescent scum is seen floating on the solution. This effect is termed stripping, and is due to the solvent action of a too dilute bath; for this reason stronger solutions are used than would otherwise be necessary. Prolonged floating is apt, with a moderately dilute solution, to soften and partially dissolve the albumen, thus leading to its severance from the paper; but, on the other hand, a short period of floating is not instrumental in producing vigour, inasmuch as albumenate of silver—which forms very much slower than silver chloride—would not be present in sufficient quantity. The dish employed for sensitzing should not be used for any other purpose. The requirements are that it should be flat and perfectly clean. When porcelain dishes

have been used a short time, the enamel or glaze cracks all over, the dish thereby becoming useless for the purpose. Ebonite dishes of large size are seldom flat when new, and warp very much after a little wear; therefore a strong wooden frame of pine or teak, with a plate-glass bed, seems to last better than anything else. The wood should be well rubbed with solid paraffin, which has the property of completely resisting the action of nitrate of silver. Such a dish, well made, will last a lifetime. A glass rod may be attached to the end of the dish to drag the wet surface of the paper over, which not only allows of quicker drying, but prevents waste

Sensitizing.—Having dusted the dish with a flat camel-hair brush, pour out the sensitizing solution until it has attained a depth of half-an-inch or more equally all over the vessel; drag a band of paper over the surface to collect scum, if any; take a sheet of paper, dust it with an old silk handkerchief or soft dusting brush, then lay it steadily (albumenized side downwards) on the surface of the sensitizing bath in such a manner that air-bubbles are not formed; neither must the silver be allowed to touch the back. This may be accomplished by floating in the manner described in the second chapter on albumenizing. On no account must a halt take place as the sheet is first laid on the liquid, or a line representing the stoppage will be the result. As soon as the paper has been laid down, it should be lifted by means of a glass rod at one of the corners, and examined. If the operation has been successful, there will be no air-bells attaching themselves to the sheet, but should there be any, they may be easily removed with the glass rod, or blown off. The sheet is again replaced on the bath, and allowed to remain long enough to become fully sensitized. The length

of time will be found to vary; for instance, if one is using paper which has been albumenized a few months, and so matured, and especially if it has been stored during the latter part of the time in a damp room, three minutes will, under ordinary circumstances and at moderate temperatures, be sufficiently long; but if the paper is freshly prepared, or very dry, it is liable to repel the solution, and will take as long as five minutes in warm weather. On cold days, longer floating is required than is necessary when the temperature is from 60° to 75° F., unless heat be applied.

When the sheet is down on the bath, it will be seen that it does not lie perfectly flat. After the space of a little while it becomes absorbed with moisture, and will present an even surface. When that period arrives, whether it requires three minutes or longer, the sheet is ready for removal. Raise the farthest corner of the sheet to the left, off the solution, by means of a glass rod. Seize it by the left hand, raising the sheet slowly; now take the nearest corner with the right hand, and draw the sheet steadily and slowly over a glass rod fixed at the end of the dish; if this is carefully done, all excess will be removed, and the sheet will be dry in a few minutes; suspend it from one corner (albumenized side outward) by means of one of the American clips in the drying room.

Machine-made paper, when wet, expands, and contracts upon drying. Sensitized paper is not an exception to the rule. Now, if this expansive and contractive property acted equally, no disadvantage would result; but such is not the case. It has been found that the manner of drying has some influence on the result; for that reason, therefore, it is customary for most printers, when they remove the wet sheet from the

bath, to clip it by one corner first, then another, and so on until it has depended from each about an equal length of time, and become dry. The sheets may then be piled up, albumen side down, in order to become flat, for the purposes of fuming, or may be at once packed for use. Sensitized paper should not be permitted to lie about exposed to the atmosphere longer than is absolutely necessary, or discolouration will take place. A spot of silver solution reaching the back of paper during sensitizing ought as soon as possible to be blotted off with bibulous paper, or a red mark in that portion of the sheet will be the result when printed.

Should it transpire that any excess of sensitizing solution, left upon the paper after its removal from the bath, forms in streaks or tear-drops, the whole of that sample of paper should be blotted off with clean white blotting-paper when withdrawn from the silver bath, otherwise stains and uneven patches may be expected. Paper which curls obstinately after laying down on the bath is too dry; breathing over the curled portion is often a remedy, but storing in a damp room is a preventative.

The solution should be stirred with a glass rod after the removal of each sheet of sensitized paper, in order to retain tolerable equality of strength. By the time ten sheets have been floated, about 290 grains of silver nitrate will have been converted into chloride or absorbed. This should be replaced by means of 4 fluid ounces of a strong stock solution of nitrate of silver, made by adding 36 fluid ounces of water to 6 ounces of re-crystallized silver nitrate, and the solution be agitated to ensure mixture. If a less quantity than ten sheets are floated, the end may be gained by making a diamond scratch on the bottle at 80 ounces, and, whenever the bath is poured

back, add strong stock solution to bring the bulk up to that mark. It is recommended that as soon as sufficient paper has been sensitized, the remaining solution be returned to the bottle provided for that purpose, in which a small quantity of sodium carbonate is always kept. After adding strong silver solution to make up the bulk, it is a good plan to let it stand until again required, when it can be filtered. The dishes employed should be rubbed well with a sponge and clean water, then finally rinsed quite clean, and placed upon the shelf, out of the way of dust, to dry. Unless this is attended to, scum marks will certainly appear when used again. The washing water is saved to recover the silver. A mercury testing bulb, called an argentometer, is sold for the purpose of ascertaining the strength of silver contained in a solution with water, but it is not very precise. A more satisfactory method will be given at the end of this book.

CHAPTER IV.

AMMONIA NITRATE AND OTHER SENSITIZING BATHS.—PLAIN PAPER PRINTS.

The ammonia nitrate of silver sensitizing bath is of a distinctly alkaline character. The paper sensitized thereon is energetic, but discolours after a few hours to such an extent that it cannot be relied upon in a humid atmosphere, especially for printing vignettes. It should not be of less proportion than sixty grains of silver nitrate per fluid ounce when made, and that strength afterwards kept up, or loss of brilliance from dissolution of albumen will be likely to ensue. Replacing 10 per cent. of the water with that amount of methylated alcohol tends to prevent this happening. The customary plan of preparation is as follows :—

Silver nitrate...	...	...	...	11½ ounces
Soft water ...	...	...	...	80 ,,

When dissolved, add liquor ammonia fortis, drop by drop, which will cause a dense brown precipitate to take place; continue adding ammonia in small quantities, until the solution has become clear. There is another method in which the solution is divided into two parts, one being treated with ammonia, and the unacted upon portion afterwards added; but the mode given above is the most simple.

It has been claimed for this bath that the prints produced are more permanent, in consequence of less albuminate of silver being relied upon in gaining a vigorous print. The writer does not, however, commit himself to an opinion thereon, but merely mentions that some prints he made in

this way about twenty years ago have stood the test of time remarkably well. Can as much be said in favour of prints in which organic silver compounds play a very important part?

It was stated in the last chapter that other nitrates are sometimes used in compounding a sensitizing solution, in addition to silver nitrate; it has also been set forth that the strength or number of grains per fluid ounce of silver nitrate should be in proportion to the quantity of silver nitrate contained in the paper. This may be considered a safe rule to work by, but as the addition of other nitrates has already been mentioned, it will naturally be asked why they are used. The answer is—they are intended as a partial substitute for silver, thus enabling more dilute solutions of silver nitrate to be employed. An instance of that claim will be found in the following formula, wherein a paper heavily salted—that is, containing twelve to eighteen grains of a soluble chloride per ounce of albumen—may be made to yield rich prints with a small proportion of nitrate of silver. There are many formulæ given, but the one which follows these remarks commends itself for its simplicity, and will be found quite efficacious.

Nitrate of soda...	...	...	...	40 grains
Nitrate of silver	...	...	...	20 ,,
Ordinary water	...	...	...	1 ounce

The time required for floating will be from six to eight minutes, according to temperature.

Another very excellent formula is:—

Nitrate of potash	...	...	...	35 grains
Nitrate of silver	...	...	...	20 ,,
Ordinary water	...	...	...	1 ounce

Float three to five minutes, according to temperature. Paper so sensitised will require ammonia fuming for a quarter of an hour or longer. The process of fuming will be treated fully in Chapter VI.

The value of camphor in the sensitising bath is not very pronounced. Beyond the fact that it tends to prevent discolouration, little else can be claimed for it. Those who use it keep a lump of camphor in the stock bottle; as it is almost insoluble in aqueous solutions, a small piece lasts a long time.

Common alum is employed in the sensitizer by some printers as a preventative against the formation of blisters in the after processes of fixing and washing. It does this to some extent, and also checks discolouration of the solution; and it is further claimed, originally by Anthony of New York, as a preservative for sensitized paper. The writer, however, has not succeeded very well with it for this purpose. Only a small quantity is recommended. A piece the size of a pea is placed in the funnel through which the bath solution is filtered. Needle-shaped crystals by slow degrees form at the bottom of the vessel, but these do no harm, and can be filtered out.

Sugar, honey, glycerine, and similar substances are occasionally included in formulæ for sensitizing solutions. They do not call for special remark, as any influence they may have on the result is quite problematical.

Plain Paper Prints.—It not infrequently happens that a printer is desired to produce positives on a dull surfaced paper, devoid of the glaze albumen or gelatine would confer. For this purpose, either of the papers named in Chapter II.

are eminently suitable, after having undergone the following treatment. Dissolve—

Ammonium chloride... ...	... 400 grains
In water	... 40 ounces

Filter the solution, and pour into a clean dish to the depth of half an inch or more. Upon this liquid float the paper referred to, for three minutes, then remove to drying room. The plain paper now salted will keep in this condition a long time, so that a stock may be prepared for future use; the work may be done in daylight, as the paper is unaffected thereby. After drying, it should be flattened in the manner suggested for albumenised paper, Chapter II., when it is ready for sensitizing.

To sensitize, float the salted or prepared side of the paper on the usual sensitizing bath, examining for air-bells in the same manner as when sensitizing albumenized paper. Three minutes' floating will be long enough for this purpose; when dry, it is ready for use. It is improved by fuming. Some printers who seldom have commissions for plain prints, do not trouble to salt the paper themselves, but use, as a substitute, the reverse side of albumenized paper, which contains sufficient salt for the purpose. The back of the sheet is laid in contact with the sensitizing solution the usual time, and when dry, printed. The objection to this plan, when the prints are mounted, is the layer of coagulated albumen which underlies the print. Developed positives by the silver bromide process and platinotype have now almost superseded prints on plain salted paper.

CHAPTER V.

CLEANSING DISORGANIZED SENSITIZING BATHS.

With care, sensitizing baths can be worked from year's end to year's end without further trouble than the addition of silver, water, and sodium carbonate; but difficulties appear to arise with some printers, and they are therefore compelled to adopt remedial measures. The writer has no occasion to use anything beyond the above-named, but the matter is of sufficient importance to be dealt with in a separate chapter. About the first trouble met with is discolouration of the solution, which filtration fails to modify. Acidity can usually be traced, for a piece of blue litmus paper will redden if allowed to remain in the liquid a few minutes. The cause is largely due to albumen dissolved from the paper. Sodium carbonate should be added to a discoloured bath, and after well shaking, the bottle containing the liquid may be stood aside a few hours, when it will in all probability filter quite clear. Unless this happens, more sodium carbonate may be added, or a small quantity of dilute ammonia solution if the soda appears dilatory. Too much ammonia will not only render the bath distinctly alkaline, but is apt to dissolve the albumen, yield flat prints, and make the bath in a worse condition than before.

Kaolin (china clay) is an old favourite remedy for removing colour from the printing bath. A saltspoonful shaken up with the solution, if permitted to stand a few hours, renders it quite clear. The plan, unlike sodium carbonate, impoverishes the silver bath to a slight extent, and necessitates decanting the clear liquid for use.

When a bath contains much organic matter, and the prints are wanting in pluck, a decided improvement will take place if a pinch of common salt is added to the solution, provided it is afterwards exposed to sunlight for a few hours, which will cause a deposit of chloride, together with organic matter. Like treatment with potassium cyanide will achieve a similar result, but in either case the solution requires filtering, and strengthening with silver nitrate.

Permanganate of potash possesses the characteristic of attacking organic matter in solution, and can be utilised for the purpose of purifying silver nitrate solutions. Sufficient of a five per cent. solution of potassium permanganate may be added to a faulty bath until the bulk is of a magenta hue. A white or nearly colourless glass bottle is suited for this purpose. The vessel containing the liquid is, by preference, placed in sunlight, which quickly decolourises the contents; more permanganate is now added, and the quantity repeated as long as the colour vanishes in, say, an exposure of a quarter of an hour to sunlight. At that stage very little organic matter will remain, and certainly not enough to interfere with printing operations. The solution, after this treatment, requires filtering, and the addition of sufficient silver nitrate to bring it up to the normal strength. Condy's fluid (disinfecting) may be used if more convenient, but the crystals are the most economical. In the reaction, permanganate of potash ($K_2Mn_2O_8$) gives up oxygen to organic matter, and if added to excess, potassium nitrate and silver permanganate is formed.

When a silver printing bath, either from accident, design, or protracted use under trying conditions—such as the sensitizing of various albumenizers' samples, or even a change of

one brand for that of another—the sensitizer appears to be thoroughly out of order, and does not yield good prints on any sample of paper, then a remedy can generally be found in boiling down the bulk, either partially, or until the silver fuses. Commence by rendering the silver solution slightly alkaline with potassium carbonate and ammonia hydrate, then evaporate on a sand bath. If partial, boil down to one-half the original bulk, cool, filter off black scum, and dilute to proper strength with water. If complete, boil to fusing point, cool, re-dissolve in very dilute nitric acid, afterwards correcting acidity with sodium carbonate.

Probably the most complete method is the reduction of the silver to the metallic condition. Add dilute hydrochloric acid or common salt in solution to the bath until no further precipitate is caused, decant the liquid, and wash precipitated silver chloride once or twice, then heat nearly to redness in a clean porcelain basin, and cool. Cover the surface with granulated zinc, pour on a small quantity of dilute sulphuric acid to start voltaic action, and await the result. The metallic silver will, in the space of half an hour, be found at the bottom of the vessel. In order to remove adhering particles of zinc, the silver mass should be boiled in dilute hydrochloric acid for a few minutes, and the zinc chloride most probably formed, washed away with hot water. The resulting button of pure metallic silver can be dissolved in slightly dilute nitric acid, and recrystallized, or the acid solution may be neutralized with sodium carbonate. (See also Treatment of Residues.)

CHAPTER VI.

FUMING AND CUTTING UP.

So much has been written by our most successful photographic silver printers in favour of and against the practice of fuming sensitized paper with ammoniacal gas, that this work would be incomplete if a detailed description of the *modus operandi* were not included—more especially as this book will in all probability circulate largely among American photographers, who have almost exclusively adopted the process.

When ammonia hydrate (NH_3), commonly known as liq. ammon. fort. s.g. 880, is exposed to the atmosphere, pungent fumes of gas are given off. If these fumes are collected in a closed box, and sensitized paper subjected thereto, the sensitiveness will be considerably increased—in fact, nearly doubled; and the colour of the print be inclined to violet, more or less according to the energy of the gas and the length of time it is acted upon. Among other advantages, fuming permits less concentrated silver solutions to be employed in sensitizing. Less time is occupied in printing, also toning, meaning economy in time and material, and mealiness is never seen. It is for this latter reason that pictures printed on fumed paper give much better results in copying than those which are printed on unfumed paper. The writer strongly advocates the adoption of ammonia fuming by all those engaged in printing from gelatine dry plates, being convinced that it only requires a fair trial to render its use general.

Possibly the reasons why fuming is not more generally adopted in this country are—Firstly, because the fuming cupboard or box requires constructing; secondly, commercial ammonia as obtained from many places is not up to the standard; and thirdly, partly as a result of the two first reasons, because many of those who have tried it have failed.

The writer has seen all sorts of contrivances used. In one case a cupboard was requisitioned, the sheets were hung up by means of clips some sixty inches from the floor, a basin containing an indefinite amount of the liquid was placed at the bottom of the apartment, the door shut, and fuming action continued for a quarter of an hour. The drawback to this plan is, that the paper gets acted upon unequally, hence mixed batches of prints was the result, and finally the process got cast aside as impracticable and unnecessary. The following arrangement has been in daily use for a number of years at a well-known photographer's printing establishment, which is sufficient evidence of its practicability. The fuming chamber is an ordinary pine-wood box measuring 25 by 20 inches, by 18 inches deep, to which a lid is attached; to the edge of the lid moulding is screwed on, and strips of felt tacked to the upper edge of the box to prevent the escape of gas when shut; inside, and a couple of inches from the top, a light wooden frame covered with coarse netting is hinged, so as to admit of the stock-bottles being taken in or out; two or three one-inch holes bored near the lower corners of the box to facilitate free circulation of the gas; a dish on the bottom containing the liquid completes this simple but effective arrangement. To prevent failure and disappointment, attention should be given to one or two essential points.

Purchase the ammonia solution of the highest percentage

procurable—that is, a trifle over thirty—in capsuled Winchesters, costing in London at the present time under sixpence per pound when bought wholesale. Use a measured quantity—say two ounces—in a dish just previously placed at the bottom of box similar to that above described (this quantity will be sufficient for at least half a quire of paper); lay the sheet to be fumed on netting stretched an inch or two below the lid; the distance between the liquid and the surface of the paper should be fifteen inches at least. To ascertain the proper time to fume any given sample of paper—for the different makes vary enormously—it is better to start by exposing the paper in the box for one minute; cut off a corner and expose it to daylight. If the colour is red as it darkens in the light, the action has been insufficient, and it will be quite safe to return the paper for at least another minute; at the end of this time another small piece may be cut off and exposed as before. This time it may print grey, afterwards becoming purple; this is an indication that the paper is sufficiently fumed for all ordinary purposes. This information arrived at by experiment, fume all the batch that time and no longer. Some samples of paper require thirty minutes' fuming, or longer. To economise time, two sheets may be laid back to back on the netting, and turned over at half time. When there is much moisture in the atmosphere, and a weak silver bath has been employed, a peculiar mottled appearance is sometimes seen, although the purple colour has been attained. This indicates the necessity for a longer period of floating on the silver solution, followed by a prolonged fuming until the blue stage has been reached. As a rule, paper should be floated until it is seen to lie perfectly flat on the solution, whether it requires three minutes or ten to

obtain that result.* When paper has been acted upon too long by the ammonia, also when not quite dry, a grey metallic lustre and generally flat appearance is obtained. Such prints will not tone well, neither will burnishing improve them very much. Always keep the lid on the box, except when momentarily changing the paper. Be sure every sheet is quite dry before it enters the fuming chamber, and do not overtime.

Another plan of fuming is to submit felt pads to the action of ammonia, these being kept in a cupboard or box well charged with ammoniacal gas, and changed from time to time as wanted. Pads are sometimes made in the form of flat bags, and filled with carbonate of ammonia. They are placed at the back of the sensitized paper in the printing frame, but the method, although used somewhat in Germany, is clumsy compared to the direct action of ammonia gas. As soon as sensitizing, drying, and fuming are completed, the paper should be packed away in a dry place, for if it is allowed to remain lying about the room, it will soon discolour; but if it is rolled up tightly, and an old sheet of sensitized paper is used as a wrapper, or if cut up and placed under a heavy weight, it may be preserved three or four days in sultry weather, and a longer time, as a rule, without any apparent colouration. Even after a week it will do for poor negatives, as the slight yellowing will not be discernible after the prints have left the fixing bath, provided the solution be made alkaline with ammonia.

Preserving paper for a longer period will form a separate chapter.

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* Fumed paper stored in a damp room sometimes exhibits a mottled effect—especially in the shadows—when printed; re-drying generally proves a remedy.

Cutting Up.

It is unnecessary to say much in regard to cutting up the sheets, beyond mentioning the sizes mostly in use, and pointing out the disadvantage likely to occur when sheets are cut in different directions in order to prevent waste. When the photographer intends trimming his prints previous to toning, it matters little whether the paper is first of all folded and creased, then torn, or cut with a knife or scissors; but when the prints are cut after toning and washing, it will be found better to employ scissors for reducing the sheet, otherwise the rough edges caused by tearing may be the forerunner of serious mischief in the process of washing. A sheet of Rive paper as we receive it measures about 22¾ by 18 inches; starting downwards we have to print negatives 20 by 16 inches, 18 by 15, 16 by 13, 15 by 12, 14 by 11, 12 by 10, 11 by 9, 10 by 8, 9 by 7, 8½ by 6½, 7 by 5, 6½ by 4¾, 6½ by 4¼, 6¾ by 3¼, 5½ by 3¼, 5 by 4; 4¼ by 3¼—all of which are old standard sizes; besides these there are odd sizes, and what may be termed new sizes. The panel is 13 by 8; double promenade, 8½ by 8½; promenade, 8½ by 4¼, and others.

The sizes being so numerous, no fixed rule can be given as to cutting up; two pieces cannot be got out of a sheet larger than 14 by 11 size; but there will be a strip left 22 by 3, which will yield eight carte-size pieces. Thirty-two, thirty-six—or even forty-eight—carte-size pieces can be cut out of a sheet; it depends entirely upon which way the paper is folded.

It is not advisable to resort to such strict economy, however; it is a far better plan to use paper a little larger than the print is intended to be when finished. As an illustration, take the smallest size likely to be printed—*i.e.*, C.D V. from quarter-plate (4¼ by 3¼)—fold the sheet in

halves, cut it through the centre, the albumenized surfaces touching, and the corners even; fold again in halves and cut through; repeat as before until five cuts have been made. This is by far the most simple plan, and will yield thirty-two pieces of the same size, with plenty of margin for re-trimming after printing; likewise, what is of paramount importance—in portraiture at least—the stretching of the paper which takes place during the after-processes of washing, toning, &c., will most probably be equal, for each piece has been cut parallel with the shortest way of the sheet. The only exception likely to occur is in the event of the sheets having been mixed at the mill when the band is cut up into reams. Following the principle suggested for cartes, ten cabinets and eight carte pieces may be obtained from a sheet, all cut in one direction. To do this, cut off a strip the full length of the sheet, and 4 inches wide, which will make eight cartes. Then cut off another strip $4\frac{1}{4}$ inches wide from the narrow end of sheet; this, when divided, will make two cabinet pieces, and the remainder eight more. For whole-plates, divide two sheets in six equal portions, and so on upwards, endeavouring as far as possible to retain one direction of the sheet for all the prints in which distortion is likely to be objectionable. In other cases several sheets may be cut at one operation by means of a steel die of the proper shape. Ovals, cushions, dome tops, &c., may also be cut separately with a sharp knife and stout zinc shape; but unless this be done in one direction—viz., the length traversing across the narrow part of the sheet—the paper so cut should not be used where exactitude is required.

CHAPTER VII.

PRINTING THE PAPER.—PLAIN PRINTS.

It must be assumed that the meaning of the term sensitized paper is now understood—what it is, and how it is prepared. Furthermore, the special characteristic of such a paper, darkening when exposed to daylight, is fully recognized, and the need for some protection being used in the printing-room when the sensitive paper is uncovered. "Golden Fabric" is most useful for performing this latter function, since it admits light of exalted luminosity, combined with safety; and when direct light is used, some such medium to render the light non-actinic is absolutely necessary. (See I, Fig. 1.) In sheltered places, however, where only a limited quantity of diffused light is admitted, little harm will happen to paper exposed a few minutes thereto; but if prolonged, a degradation of the whites of the resulting print is sure to follow. It is true that under certain conditions, to be hereinafter mentioned, lowering the value of the whites is an advantage; but it is incumbent to point out in these instructions that the knowledge of this method of obtaining harmony in occasional instances must not be permitted to engender general indifference to the influence of diffused daylight. In a light such

as that recommended, neither the most delicately vignetted proofs or unprinted paper are likely to suffer to any extent by its continued action when in sufficient quantity to work with perfect comfort. Provision for safe illumination made, we proceed to the printing of a proof upon sensitized paper by means of light passing through a negative fitted in suitable holder. The accompanying Fig. 3 indicates what is called the printing or pressure frame, such as photographers

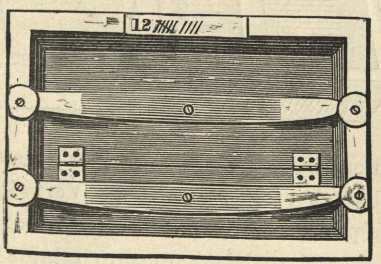

Fig. 3.

employ for negatives up to $6\frac{1}{2}$ by $4\frac{3}{4}$ inches (half-plate). The label or tablet as shown, is convenient for marking off the number of prints, and a fresh pieee of gummed paper is necessary for each negative to be printed. When a negative is large enough to admit of it, a narrow strip of adhesive paper may be permanently attached to the negative, and used as an indicator for the number of prints required. The printing frame B, Fig. 4, differs from A very little. It is stronger built and provided with a bed of plate glass, whereon the negative is laid, so that any smaller-sized negative than the plate-glass may be printed in it. As a rule, however, they are employed for the larger sizes only.

When the frame is open, light is free to pass through; but when closed, as in the sketch, light can only pass

through the negative on to the sensitive paper. The back is made in two halves hinged together, so that pressure may be

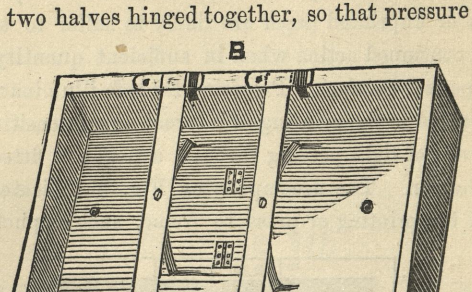

Fig. 4.

retained on one-half, while the other half may be opened to examine the progress of printing. Very little danger of altering the position of the print exists, if only ordinary care be exercised, and sufficient pressure retained on the other half.

Pressure is effected in a variety of ways. Strips of hard sheet brass answer admirably for small sizes; they may be pivoted by means of a screw at one end, the other end passing, when closed, into a wire loop, catch, or other contrivance, thereby bringing pressure to bear on the hinged backs.

It is better, when starting photographic printing, to purchase an assortment of new pressure frames from a stock-dealer. They are now supplied at very moderate prices. We will suppose we are working with a quarter-plate negative in a quarter-plate frame, size 4¼ by 3¼ (glass beds are seldom fitted to this size); the negative must lie quite flat in the rabbet; if it does not do so, either the rabbet is not

true, or the negative is not flat. If the frame is at fault, and cannot be easily corrected, it will be wise economy to discard it, or a number of valuable negatives may be broken in consequence; but if the negative is not flat, which may be seen by looking along the edge, gum one or two narrow strips of paper on the portion that does not touch the rabbet; if the negative no longer rocks in the frame when pressed at each end, it may be considered safe to apply the pressure. Put the negative down on the rabbet of the printing-frame, varnished side uppermost; pass a camel-hair brush once or twice over the surface to remove adhering particles of dust; then place one of the cut pieces of paper from store box, Fig. 1, down on the negative, albumenised side in contact with the varnished surface of the negative; upon this lay evenly one or more thickness of blotting-paper, each piece as large or larger than the piece of sensitive paper; this forms a padding to increase and equalise the pressure (a better article for the purpose, when come-at-able, is the red sheet rubber, which does not affect the print, nor cause dust like paper, felt, and padding of that description; it is manufactured any size and thickness); place the back of the frame in its proper position, and close the springs. If the negative can be moved about easily after the springs are closed, the pressure is insufficient, and more padding must be added. Blurring in the print is a proof that negatives and paper have not been pressed into contact. The pressure frame is now ready for exposure to daylight, by preference out of doors upon a printing stand, bench, or other contrivance. Let this printing stand be erected in the open air, as far away from surrounding buildings as possible, having due regard to distance from the printing room; construct it with a sufficient angle

for rain to run off sharply, and let it face due north. Photographs may be printed in direct sunlight; but any imperfections in or on the glass, such as blisters, scratches, &c., will be faithfully reproduced, unless the sunlight be filtered through a semi-opaque substance, such as tissue paper or ground glass. Moreover, many varnishes will not stand the heat produced—they become tacky; on the whole, it is better not to use direct sunlight, especially as nearly as much work can be produced by having a good expanse of north light. When it is desired to print in wet weather, the frames should be exposed to light under glass. Printing takes place much slower than as previously described. We will assume the weather chosen for printing be fine.

Having charged the frame with a negative, paper, and padding, and secured the pressure, place it, glass side uppermost, on the bench out in daylight. After the lapse of five minutes, the progress of printing should be examined; until the student is master of the art he should do this in the printing-room, or he may find the whites of his print very much degraded, more especially the vignettes. To examine progress, unfasten the spring nearest the head (if it be a portrait), with the right hand, holding the frame, glass side inwards, securely by the left hand; with the right gently open the released half of the back outwards. Next raise the pad and print by one corner; the paper previously white will now have an image printed on it, perhaps deep enough; or it may be only just marked, depending upon the density of the negative, and the strength of the light. It should be closed up with care, or the paper may not find its way to the position from which it was lifted. Such an effect is observable when we get a double impression. Turn the frame upside down, release the other spring now at the top, and

examine the other half of the print. If it is progressing satisfactorily, close it up carefully, and again place it out in the light. This operation may be repeated at short intervals until the print is finished.

In ordinary practice, any portion of a print becoming too dark may be covered with a piece of yellow paper rather smaller than the shadow to be blocked, the most convenient mode of procedure being to gum it on to a piece of glass the same size as the printing-frame, the position of the paper being just over the shadow. The proper time to stop the action of printing can only be determined by individual taste; but we may say that, as a rule, the printing may be continued until there is slight shading or tone exhibited through all the lights—that is, where the dense parts of the negative have been—excepting the extreme high lights in portraits, such as the most opaque parts of forehead, chin, &c.; we shall then have a print just a trifle deeper than we require when finished. The reason why we print deeper will be seen when we tone our print. It will be sufficient here to mention that the prints become lighter in the after operations, depending on the treatment adopted.

In the case of dense and under-exposed negatives, sometimes the shadows will be bronzed before the lights are barely touched; this is very noticeable in some harsh, under-timed landscape negatives. We may be desirous of printing them, although they are not up to the mark; and exposing the paper to daylight before or after printing, either to the front or back, has been found useful for the purpose. But if several prints are required, and harmonious results expected, we have recourse to further dodging, and recommend the following:—Cover the back of the negative with *papier*

minéral or a similar substance, securing it to the edges of the negative by means of gum; cut the paper away from above the dense portions, so that light is not obstructed. Secure the remainder to the negative with a touch of gum, and apply sparingly some powdered plumbago to that part of the paper which covers the deepest shadows. Cloud effects may likewise be produced in view pictures by stumping in with plumbago where necessary. Sometimes negatives are exactly opposite to the foregoing in printing quality; the lights not being dense enough will be printed fully before sufficient strength has been gained in the shadows; such prints look weak and flat when finished. In cases of this kind a stronger sensitising bath and more fuming are both resorted to. We can also make satisfactory prints by stippling over—within the lights at the back of the negative—a little carmine or Prussian blue. When it is expected the negative will have a little wear, it will be better to use oil colour, applied with the ball of the finger, until an even density is obtained. There are only two things to guard against—that is, putting the colour on too densely, and allowing the colour to overlap the lights. In the first we produce flatness, although obtaining density; in the second, we get a halo vignetted on the surrounding parts.

The foregoing remarks, it will be readily understood, apply equally to plain prints from all other size negatives, as they do to the quarter-plate instanced.

Very little printing will be done ere the discovery is made that intensity value in a scratch collection of negatives varies enormously; so much so, indeed, that it becomes difficult for any but experienced hands to estimate anything like an approximate ratio. Therefore the inexperienced printer must

ascertain the printing power of each negative as he proceeds, and vary the conditions accordingly. Very dense negatives, which yield chalky whites minus detail where half-tone should be, and intense bronze in the shadows, must be provided for by modifications in the sensitising process. Extreme cases are best met by the use of unfumed paper which has been floated on a moderately weak sensitizing bath (about 32 grains per ounce). Should bronzing still occur after this treatment, then the sensitized paper should be washed in distilled water to remove a portion of the soluble nitrates, including free or uncombined silver nitrate. When dry, a short exposure to ammonia fuming will be of advantage, but this contingency is seldom requisite. Over-density to a moderate extent may often be met by exposing the sensitized paper to daylight before placing on the negative; or the back of a chalky print may be tinted in sunlight. The object in either case is to degrade the white sufficiently to correct the error in the negative. When the graying-in action is carried to excess, a flat and perfectly uninteresting print is the result. Direct sunlight printing is useful for dense negatives, and small patches of excessive density may be printed in by bringing the sun to a focus with a burning glass where necessary. The lens should be kept in gentle motion in order to avoid intense heat and the consequent destruction of the negative. Perhaps the best advice is to reduce the density by chemical or physical means. Weak negatives, on the other hand, should be intensified. When this cannot be done, the use of a stronger sensitizing bath and extra fuming may be resorted to with beneficial results. Slow printing under green glass in a diffused light is in extreme cases beneficial as an aid towards securing greater brilliancy.

CHAPTER VIII.

PRINTING IN OVAL, CUSHION, AND VIGNETTE.

Portraits, views, and subjects which lend themselves to artistic printing, are sometimes printed in opal, cushion, dome, and other shapes, having a sharply-defined line between the subject and the white margin which surrounds the picture. This is brought about by placing an opaque mask in contact with the negative, and securing it in the desired position by fastening the edges tightly with gummed paper, in order that each print may register similarly. Prints so produced will have white margins, but the usual practice is to expose the margins separately to daylight, until they have acquired a tint somewhat lighter than the general depth of the subject. Masks may be cut from stout, well-made needle paper, free from holes, but sensitized paper—waste prints—answers the purpose, and is perfectly opaque. Stout zinc sheet is useful for making shapes, and two zinc blocks should be cut for every shape employed; one being rather more than the thickness of a knife blade larger than the other. The object of making this slight variation in the size will become apparent when it is stated that the mask which is cut from the larger zinc block is the one which is

attached to the negative; the corresponding centre or counterpart, which is intended to mask the image during the time the margin is exposed to daylight, is cut from the smallest block; the difference in the size of the two blocks being sufficient to enable the picture to be entirely covered, while the margin is printed deep enough to produce a pleasing effect. This method does away with a white overlapping line. In adjusting oval masks to portrait negatives, at least busts, arrange so that the shoulders are evenly balanced, and do not occupy a position in the oval higher than one-third from the base.

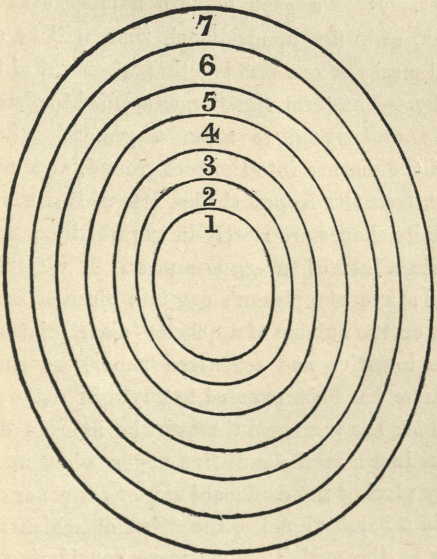

Fig. 5.

Wherever possible, provide an equal distance from the sides of the head to the outer line, so that the figure does not

appear toppling over. Before fixing a paper mask to a negative for printing, the mask should be examined by transmitted light for the purpose of ascertaining whether it be free from holes or cracks through which light could pass. Jagged edges are likewise objectionable, and should be rejected; they are usually caused by a blunt knife. The instrument used for cutting masks should have a keen edge, in order that a perfectly true outline may be obtained. Stock dealers retail sets of opaque masks which are stamped with a steel dye. The writer prefers, however, to cut his own from zinc shapes. It is a good plan to number each size and shape mask, as in fig. 5, and much time will be saved by keeping all masks of one size together when out of use.

Vignetting.—The term vignette, as applied to photographic printing, is understood to mean a gradual softening or blending of the picture into the background, or a portion of any picture, from the deepest shades, into white surroundings.

Two definite shapes are mostly in use for this purpose, and take the form either of an egg or a pear. If we cut a hole the size and shape of a pigeon's egg in a piece of cardboard, and place it on the outside of a quarter-plate printing-frame containing a negative and sensitized paper, we shall find, after the frame has been exposed to daylight some minutes, the light which has traversed through the hole in the cardboard has produced on the sensitive paper what we term a vignette; by placing the cardboard close to the negative we should obtain a harsh vignette, the effect of which is somewhat similar to the medallion we were considering above; but the outline, instead of being sharp, would be undecided or blurred in proportion to the thickness of the negative plate. Such an effect is both undesirable and inartistic.

Place a piece of thick glass between the same negative and the cardboard, also a fresh supply of sensitive paper, and print as before; upon examination it will be noticed that this second print will exhibit far more gradation than the first. Within reasonable limits, the more we increase the distance between the two, the softer and more perfect will the gradation be. Having become acquainted with the meaning of a vignette, and an easy mode of producing it, we

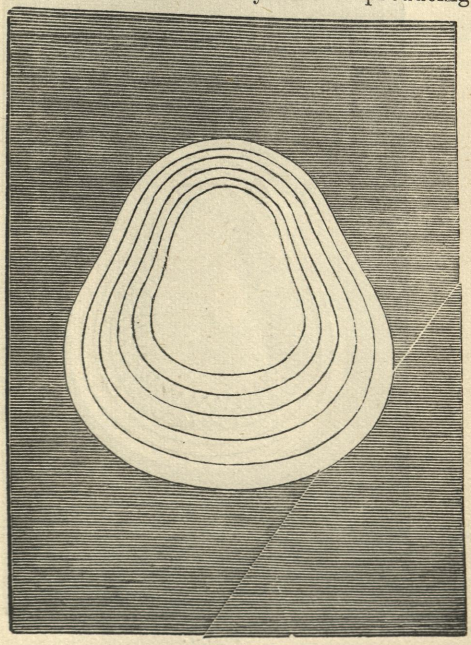

Fig. 6.

will mention some of the arrangements employed by photographic printers to obtain similar results.

The vignetting glass, now almost obsolete, has done good

service. It can be made by removing the colour from the centre of a sheet of flashed ruby glass by rubbing with slightly dilute hydrofluoric acid. When due care has been taken in the production of these glasses, they may be placed in contact with the back of a negative, and good vignettes are obtainable in a strong light, which makes them valuable for rapid printing. Vignetting papers (an article of com-

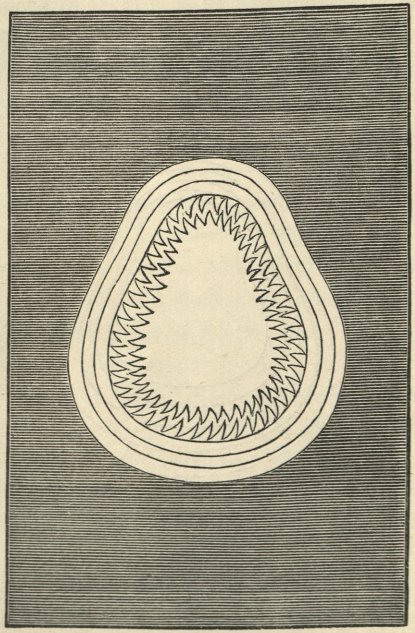

Fig. 7.

merce) are excellent for the purpose; they may be prepared by stippling oil colours, the shape required, on tissue paper which has been previously soaked in melted paraffin, the colour becoming denser as the shape is enlarged. The width

of stippling need not exceed half-an-inch; while the part intended to be opaque can be covered with yellow paper. A result almost identical can be attained by cutting a series of openings in tissue papers, the openings being progressive, as in sketch (fig. 6).

Empire cloth, the material sometimes used for backgrounds, is an excellent article for the manufacture of vignette shapes. Those who wish to use it should proceed as follows. For a quarter-plate frame, a strip measuring six inches by

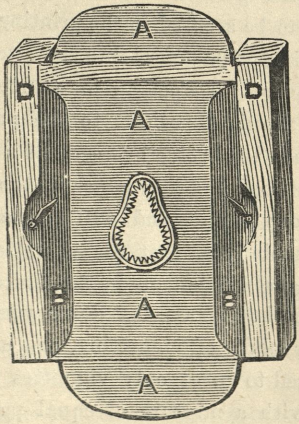

Fig. 8.

D D is the printing-frame; B B, Empire cloth binders; A A A A, moveable slip, passing through two glass plates.

two and a-half should be cut, and an opening made about a quarter-of-an-inch larger all round than would be necessary with cardboard, cover this orifice with some thin, light material, such as cambric, securing it with paste; when dry, cut out the centre, and Vandyke the edges as in fig. 7. Grind the edges of two quarter-plates, and bind them

together at the sides by means of the same material, leaving the top and bottom open, with sufficient room between the plates for the vignetting shape to be moved about; the advantage of these shapes being, that they are not affected by damp, like paper. The opening can be easily shifted to any part of the negative during the progress of printing, either by raising or lowering the slip, or moving it from side to side; and it will be found advantageous to alter the position of the opening during printing in the case of thin negatives, in order to obtain a still greater degree of softness. The whole arrangement can be secured to the printing-frame by a couple of buttons, as in fig. 8. Very fine vignettes may be obtained with an ordinary oval opening in cardboard or sheet-lead secured in the required position to the printing-frame, the latter being made to revolve by means of a turn-table. One advantage sheet-lead has over paper is, that it can be easily hammered to any shape, and will last a very long time. Indeed, so valuable is it, that the vignetters at one of the largest printing establishments in the United Kingdom have used no other method for the last dozen years.

Among other plans of vignetting, we may mention that when it is desired to print only vignettes from a negative, coat the back with a mixture of equal parts of japanner's gold size and turpentine; while tacky, rub powdered plumbago wherever it is intended to keep the paper white, softening off gradually to the requisite shape with a pad or stump; excellent vignettes are with care obtained in this manner. Another plan of a similar nature is, to thin Bates' black varnish with turpentine. Coat the back of the negative with this mixture; when nearly set, remove (by means of a rag dipped in turpentine) the varnish from over the parts

to be printed, softening off the edges at the same time by dabbing them with the rag. Either the plumbago or black varnish methods may be utilised for effectively producing clouds in landscape negatives, but skill is requisite to produce satisfactory results.

Returning, again, to the cardboard shape, we should mention that some printers cover the opening with tissue paper; printing in direct sunlight is then advisable. Others soften the sharp line of the cardboard by Vandyking it out like the teeth of a saw, as in fig. 7, or attaching (so-called) cotton-wool by means of a touch with the gum-brush, and, when dry, pulling it out into the finest shreds possible. There are other methods, but the foregoing are the most practical, and one or other of them will be found in use in most establishments having any vignetting to do.

A toned-in vignette signifies a vignette which is surrounded by a neutral grey tint instead of white; they are especially suitable for three-quarter length portraits, and, when nicely executed, are a very pretty style of photographic printing. Roughly cut out in cardboard or sheet-lead, a vignette shape is capable of showing as much of the figure as will look well, always, where possible, including some of the background on each side of the figure to balance the picture. It will be advisable to make a trial print with the shape, and, if suitable, use it as a shield for the other prints. Cut away all the white margin, leaving only the vignetted portion, and, in doing so, it is better to keep well within the vignetting, so that the shield or mask may be a little smaller than the vignette.

Gum the shield to a piece of glass at least as large as the print to be treated, albumenized surface being outwards;

when dry, it is ready for use. Make a second print exactly as before; but this time, instead of cutting it, place it, printed side upwards, between two glass plates. The inner portion must now be protected by placing the shield already cut immediately over it; over-lapping must not be permitted; the soft gradation should be seen equally all round the shield. Now place it out in a subdued light, moving the shield gently until the white paper has darkened to a deep grey; remove it to the printing-room, and examine; if perfect, the tone should be even, and blend into the vignetting. A line of light over any portion of it will be due to the mask being too large; halation surrounding the figure may be from the same cause, or from not printing the surrounding or second portion to match the first.

Views with figures, and portraits with studio backgrounds, such as exterior or interior, conservatory, &c., are sometimes considerably improved by vignetting, and some charming results can be obtained by blending gradually from the figure to the edges of the plate. To do this nicely, the vignette shape is made as usual to print the figure or figures as the case may be. When printed sufficiently, the mask is removed, and the whole exposed to a good light for a minute or two; the time to stop the action may be known by all the deep shadows showing on the print.

CHAPTER IX.

CAMEO VIGNETTES.—ORNAMENTAL BORDERS AND COMBINATION PRINTING.

An effective style of printing, especially suited for heads, is that named cameo vignette, a class of photograph in which a portrait or other subject permitting of such treatment, is vignetted by one of the methods recorded in the last chapter, and subsequently centred in an oval shape formed by an embossing press. The margin may be white, in which case the result amounts to an ordinary vignette with an embossed centre, or a marginal tint may be printed thereon, to any desired depth. Oval masks, and the counterparts corresponding in size to the die of the embossing press, can be obtained from stock dealers, and to produce a cameo vignette with a tinted margin necessitates in the first instance the production of a good, plain vignette. Upon the figure portion of this print, and well centred, an opaque mask is placed, due regard being paid to the position it occupies. (See remarks for fixing medallion masks in the last chapter.) Lay the print and mask, face downwards, in a printing-frame with a glass bed, being careful not to disturb the position; add the

pad, back, close the springs, and print as for an ordinary print; any depth of printing may be given, this being entirely a matter of individual taste.

Ornamental Borders.—Marbled, or any other pattern, may be obtained for the border in the same manner, by substituting a negative of the chosen design for the plain glass. Thus, not only marbled and watermarked papers may be selected for this purpose, but bookbinders' imitation morocco and other fabrics; also unvarnished veneers, when photographed, lend admirable assistance in securing picturesque effects. A slightly under-exposed negative of any of these subjects answers, provided it be kept thin, and a lightly printed impression upon the margin of the cameo-vignette frequently adds to its attractiveness. It may be contended that such an effect does not surpass a plain India-tint, obtained by printing through plain glass, but it certainly opens up a field for variety. Lightly printed designs of this character may be impressed upon ordinary vignettes, and, when well chosen, yield a first-rate result. In this instance, an ordinary vignette is produced; the print is then placed in close contact with a negative of the chosen pattern, and pressed up tightly in a printing frame, as in the case of plain printing. A mask corresponding in shape, but somewhat smaller than the printed image, is then super-imposed upon the outside of the negative in order to protect the figure from being marked with the pattern; the printing frame is then exposed to daylight sufficiently long to imprint the design weakly upon the white paper of the print. When too darkly printed, the effect is liable to be crude.

Combination Printing.—Sometimes it may be thought desirable to alter the whole composition of a negative, or rather

the prints produced therefrom; such, for instance, as the substitution of a plain background in the print for that shown in the negative. Suppose this be a distant landscape, with figures posed in the foreground, we commence by making a plain print from the negative as it is. We next, with a sharp knife, dissect the background close to the figures, continuing by some well-defined lines adjacent thereto, such as a fallen tree, hurdle, or other accessory, across the picture. The upper section or background is carefully adjusted on the varnished side of the negative, the extreme edges at top and side being secured with gum. Premising that this cutting-out of the print has been skilfully accomplished, the lower portion will be an exact counterpart, and should be attached to a sheet of glass by means of gum, in the same manner as recommended for making toned-in vignettes, Chapter VIII.

If we take a print from the negative now, the background will be white; to obtain a neutral tint we have only to place the cut-out figure portion over the figures, to shield them from the further action of the light, when we are enabled to print in a background of any depth we choose. By substituting negatives for plain glass it will be found quite easy to block out the original background and print in another; besides backgrounds, we advise an attempt on foregrounds, figures, accessories, and skies, for these may be successfully accomplished after a little practice and a few failures.

Seaside subjects frequently suffer, owing to the flat and uninteresting condition of the water at the time the photograph is taken. Perhaps another negative of the same place may be perfect in this respect, but lack other qualities. By combining the good points of each in the manner above instanced, satisfactory prints can be obtained.

Cloud Effects are produced in a variety of ways, the most practical being to obtain a series of good cloud negatives, selecting the most suitable for the subject; but very good work, by the black varnish and gold-size methods previously mentioned, is turned out by those who are possessed of skill in this direction.

Negatives having good density in the sky portion rarely require stopping out beyond ordinary shading. When the subject will allow it, a duster, or strip of thin sheet lead suitably arranged outside the pressure frame, will stop most of the light from passing through that portion of the negative. Some landscape and architectural subjects would be difficult to vignette in this way; nothing short of obscuring the whole of the sky by means of an opaque substance will be found to answer. The best medium is black varnish (asphaltum in benzole) applied at the back of the negative. Care must be taken not to use it too thin and allow it to spread beyond the parts to be covered.

A print from this negative will have a white sky, and requires to be exposed under a sky negative for a short time in diffused daylight, covering up the picture as much as can conveniently be done. The sky negative should overlap the subject a little, unless there are special reasons for not doing so.

As it is customary to make use of very thin, and consequently quickly printing negatives for the introduction of skies, and, further, as darkly printed sky effects are in the majority of subjects unnatural, inartistic, and heavy, the beginner should accustom himself to stop printing as soon as the clouds are well marked in; then the loss which takes place in toning will, as a rule, make the time of printing

correct. The further preparation of negatives for printing will be treated under the heading of "Retouching," and we have only now to add that combination printing, after the difficulties have been surmounted, will be found to possess a charm peculiarly its own. Its capabilities would afford matter sufficient to fill these pages; therefore, in the limited space at di sposal, we can only indicate its use in making or improving photographic pictures. That this class of printing is held high in the estimation of the judges at photographic exhibitions is proved by the fact that a skilful composition rarely fails to obtain an award.

CHAPTER X.

TONING.

It has been shown that sensitized paper and prints rapidly discolour in daylight; in this chapter the intention is to describe the means of rendering the prints, if not absolutely permanent, at all events stable enough to retain their vigour for some years. This desirable end is attained by what is termed the processes of toning, fixing, and washing.

Toning is the operation which ultimately determines the colour of the finished print. Briefly described the print is composed, as stated in Chapter III. of silver sub-chloride (Ag_2Cl), and silver albuminate, *plus* other organic silver compounds which we need not now consider. There is, however, an excess of free silver nitrate, also ammonium or other soluble nitrates, retained in the paper, which it is incumbent should be in great part removed. Fortunately this can easily be done by soaking the prints in water, which leaves the image unaltered.

By submitting the washed print to the action of a diluted solution of gold terchloride ($AuCl_3$), chemical change will take place. A portion of the silver sub-chloride will be acted upon, re-converting it into silver chloride, and receiving a deposit of gold dependent upon the time the

action is continued, and the restraining power of the compounds added; likewise the amount of free silver nitrate left in the print. The longer a print is subjected to the toning bath, the more gold will be deposited, and the tone will be colder in consequence, but not necessarily more stable.

According to this rule, if warm brown tones are required, the prints should remain only a short time in the toning solution; purple tones will be obtained by continuing the action a little longer, and blue tones by prolonged immersion. It will be noticed that prints become somewhat reduced in vigour while being thus acted upon, due to the bleaching action of chlorine, but not nearly to the extent produced in the after operation of fixing in sodium thiosulphate, wrongly called "hypo," where the silver chloride is dissolved out, leaving the image composed of metallic silver, upon which is deposited metallic gold. When the fixing salt has been eliminated by copious washing, the print may be said to be unalterable by light, although the writer does not wish the student to understand that silver prints are absolutely permanent, for experience leads photographers to regard their stability with a great deal of suspicion.

Cutting.—It is more economical to cut the prints before toning, therefore it will be found convenient to trim them to the required shape before putting into water. This should be done in the printing room, using only yellow light. The cutting shape is a piece of plate glass, cut and ground or polished at the edges, the exact size and shape the print is to be. Take, for instance, a cabinet mount with line round the margin, or one of the stout bevelled edge mounts, the cutting shape should measure about $5\frac{3}{4}$ inches by $3\frac{7}{8}$; an ordinary cabinet mount measures between the lines $6\frac{1}{4}$ by 4

inches; when mounted, the print will show $\frac{1}{16}$th of an inch margin at the top and sides, and $\frac{3}{8}$th of an inch at the bottom beyond the print.* Cutting shapes of all sizes may be obtained at the dealers in photographic materials. Lay the print face upwards on a piece of plate glass, place the shape on the top of it, and adjust it in position in such a manner that the centre is equally balanced, and means, if the photograph be a portrait group of, say, three persons, the centre figure should be midway between the two sides. For a head and shoulder vignette, let the chin be the centre; for a three-quarter length portrait, the centre should be a little lower, reaching to the chest; this admits of sufficient background or space above the head to balance the rest. When adjusted, cut away the excess of paper by passing a sharp penknife round the edges; scissors may be used, but a little practice is required, or the lines will not be cut true to the shape. *Jagged edges are inadmissable.*

Washing away the Free Silver Nitrate.—Place the cut prints face downwards in a vessel of water, putting each in separately to avoid one sticking to another; keep them moving by gently pressing downwards for the space of three or four minutes; the water, previously clear, will now be opalescent; pour into a large jar, to be afterwards treated for residues; more water must now be added, the prints separated, and the water again poured off into the jar. After three waters have been poured off, the prints will be ready for the toning bath. It is the custom of some American printers to add one ounce of glacial acetic acid to each gallon of the fourth or last washing water. When the

* Some allowance for expansion must be made.

acetate toning bath is used, the plan is commendable, especially when fuming is adopted. The prints should remain at least five minutes in the acidulated water, and must be well moved about to prevent unequal action. The acid treatment slows toning. English printers obtain a somewhat similar result by adding one ounce of common salt to each gallon of the last washing water; but it should be observed that either acid or salt treatment would hinder the process of toning preserved sensitized paper enormously, owing to the circumstance that such papers of commercial origin are usually prepared with an acid. When it is known that preserved sensitized paper contains an organic acid, toning will be greatly facilitated by neutralizing the acid first. This can be in a great measure effected by rendering the fourth or last wash water alkaline with washing soda—one ounce of washing soda to each gallon of water answers.

Toning Bath.—The numerous published formulæ for toning baths, all of which contain some merit, renders it difficult to particularize; a selection will, however, be found in the Appendix, and in the present chapter a good workable formula is included. The bath known as the acetate seems to be in more general favour than any other, and with care can be used every day for a long period, by the simple addition of stock solution when it shows signs of exhaustion. Almost any tone may be procured by means of it.

No. 1.

Acetate Bath.—Make up the following stock solution:—

$AuCl_3$ (terchloride of gold)	60 grains
Prepared chalk	240 ,,
Water	10 ounces

Shake up, and leave to neutralize traces of acid.

No. 2.

Place in a jug—

Acetate of soda ...	...	...	...	1 ounce
Clean common salt	...	...	...	½ ,,
Boiling water ...	...	...	...	50 ounces

When dissolved and cool enough, mix. After a vigorous shaking, put aside in a dark place for twenty-four hours to settle. To make up the toning bath, pour off six ounces (let it be clear) from the stock bottle, and dilute it with one gallon of water, which will be sufficient to tone eight or ten sheets of fumed paper.

The toning bath most suited to prints prepared with preserved sensitive paper is the tungstate of soda, or the borax formulæ; both are distinctly alkaline, and yield more satisfactory tones than the carbonate, or acetate with or without the addition of common salt. A list of the principal toning baths in use, and their components, will be found in the Appendix.

Toning.—Pour the toning solution out into a clean shallow dish, the larger the better. Porcelain dishes of various sizes are sold for the purpose, and should not be used for any other. Place about twenty or thirty prints in the liquid, one by one, face downwards, agitating the while by rocking the dish, to avoid the formation of air-bells; it should be so placed that very subdued white light may fall on it, when required, so that the colours of the prints may be properly judged. After the space of five minutes, the prints should be turned face upwards, one by one, when it will be seen that they are still red. If the dish is large enough to allow of it, another twenty prints may be put in as before, face downwards; a little white light is now allowed to reach the

prints. Commence by turning over half-a-dozen of the prints last added, laying them face upwards in one corner of the dish, against the source of light, but in the solution; next pass each print of the first twenty or so towards the half dozen red ones. A slight difference in colour will be noticed, but not sufficient to warrant the removal of any one print; draw them back again carefully through the solution, and pass them again, one by one, to the same corner of the dish, this time turning up the remainder of second addition. Some of the prints first added, when compared with those freshly turned up, will be found to be verging in colour to a warm violet. If warm tones are desired, the prints of that shade should be removed from the bath, and placed in a vessel of water containing one ounce per gallon of common salt, which arrests further action of the toning: ordinary water does not do so perfectly.

After a few prints have been removed from the toning solution, more may be added from the washing water, face downwards as before, and treated precisely as the others have been, until the whole batch are toned. If cold tones are required, the prints should remain for a longer period in the toning bath. When they arrive at the blue stage they may be removed. If any doubt exists in the student's mind as to whether the print be sufficiently toned or not, he will find it a good plan to hold it up against the source of light; the colour, as seen by transmitted light, will be pretty nearly the colour of the print when finished; but notwithstanding the foregoing instructions, practice is the best guide for indicating the exact time to remove the prints, owing to some papers becoming much warmer than others during the after process of fixation. A few points essential to good

work in ordinary practice should be impressed on the student as follows. Always cleanse the hands and the vessels to be used previous to soaking the prints in water. When the toning is finished, pour the solution back into a clean jar, to be kept for that purpose only, and place it on the shelf protected from dust and light. When again required, pour off the clear solution, and throw the sediment found at the bottom into the residues, as it contains both silver and gold: add a measured quantity of stock solution, and stir it up well before the prints are added—*i.e.*, one ounce or less per sheet. Avoid placing too many prints in the bath at one time, and keep them constantly agitated. The number of prints above recommended applies only to small sizes. When toning 8 by 10 or 10 by 12 prints, not more than two or three should be in the bath at one time, unless a larger quantity of solution is employed than we have mentioned. Do not use the solution stronger than indicated in the formulæ. Fifteen to twenty minutes in ordinary temperatures will be about the average time required when a good sample of terchloride of gold is used. The temperature of the above toning bath should not exceed 80° F., or at any time fall below 60°. Inattention to this detail may be the cause of blisters.

After all the prints have been toned, the vessels should be washed and put in their places; give the prints two changes of water to free them from traces of the toning solution. They are now ready for the process of "fixing," which will be described in the next chapter.

Note.—Subdued white light admitted in the printing room during toning must be used with extreme caution, as the prints are not safe until after fixation.

CHAPTER XI.

FIXING AND WASHING.

Fixing the print is that part of the process by which the sensitive salts remaining in the paper after toning are dissolved out, leaving the image composed of metallic silver, upon which is deposited a thin layer of metallic gold. The most suitable agent we are acquainted with for dissolving these chloride salts, and the one universally employed for the purpose, is sodium thiosulphate ($Na_2S_2O_3$), known among photographers as "hypo." As a fixing agent, this substance is largely used, and it has the recommendation of being one of the most useful, and positively the most destructive, chemical found in the photographic laboratory. To be forewarned is to be forearmed; therefore, with such a character, the student should be most careful not to spill any about the floor, to be afterwards kicked up in the form of dust, drop a portion into any other solution, or wipe his hands on the printing-room towel, or other cloths, while fixing, without having previously washed them. Innumerable failures are often traced to a little laxity in this respect, and it should ever be remembered that sensitized paper and alkaline toning baths are instantly spoiled beyond the possibility of remedy when they become tainted with the fixing agent.

The quantity of solution to be made up must be decided by the amount of work in hand. Batches consisting of two

dozen prints of small size can be fixed in a pint of solution; but for quantities of ten or fifteen sheets, a bath containing at least three gallons should be used. Considering the destructive nature of this salt when in communication with an unfixed print, or slight traces of it finding its way into the toning bath, the fixing solution should be prepared some time previously in another apartment, and fixing the prints had better take place there as well. It is better to prepare the fixing solution some hours before use, in order that the temperature, which is at first extremely low, may rise to an equality with other solutions, otherwise blisters may be anticipated. The proportion of crystal to water should be about 1 to 5. When small quantities are employed, it is usual to make it fresh every day, and slightly alkaline by means of ammonic hydrate (NH_3); this prevents the liberation of sulphurous acid, the presence of which would inevitably cause the prints to fade. After the bath has been used once for prints, it need not be thrown away because it is inexpensive; it will answer quite as well for fixing gelatino-bromide films as freshly-prepared, and should be eventually treated with liver of sulphur to recover the silver.

Opinions differ regarding the use of a fixing solution more than once—and, for small quantities, once only should be the rule. When in bulk of, say, four or five gallons to fix as many hundred prints, the solution may be employed with more crystals three successive days, provided it be strengthened each day, and kept slightly alkaline.

In the process of fixing, a double salt of silver and sodium is formed, which is only soluble in excess of sodium thiosulphate. This being the case, a dilute solution of hypo only partially fixes a quantity of prints, and they would, under

these circumstances, leave the bath charged with the double salt referred to, and perish soon afterwards.

To make a small quantity of fixing solution, dissolve sodium thiosulphate 4 ounces, in warm water 20 ounces. When cold, add ammonic hydrate, 5 minims. A wide-mouthed bottle will be a useful vessel to keep for this quantity.

Fixing.—Pour the fixing solution into a deep flat dish; the toned and washed prints being in a vessel of water near at hand, transfer the prints, one by one, from the vessel of water to the fixing bath in the following manner. With the right hand withdraw a print from the water, and drop it into the fixing solution. With the left hand press it face downwards, repeating the process until all the prints are added. Let the vessel used for washing be put in its place before the right hand is allowed to touch the fixing solution. By a strict observance of this rule, a frequent source of failure is removed. If many prints are to be treated, it is better for one person to drop the prints into the solution, while another separates them.

It is all-important that the prints should circulate freely in the solution during fixation, otherwise unequal action will take place, and, if this is not apparent in well-marked stains, it will certainly result eventually in yellow patches of what is, in all probability, the double thiosulphate of silver and soda above referred to. To prevent such an occurrence, turn the prints one by one face upwards, then all face downwards, and continue turning for the space of fifteen minutes from the time the last print was added from the washing water.

Prints treated as described will then be thoroughly fixed, and if examined by transmitted light, should appear clear in

the white portions, and a general tone through the shadows. The next step is to collect the prints in bulk, drain off the superfluous liquid, and separate, either in a vessel of clean water, or a dilute solution of common salt. At least four changes of water should now be given, separating the prints each time. They should be next placed separately on a sheet of plate glass, or a flat porcelain dish, and pressed with a sponge to remove as much of the water from them as possible, after which they may be put in the washing apparatus.

Washing Appliances.—Photographers are more divided in opinion as to which is really the best mode of washing their prints after fixing than might be expected; each one avers his method to be correct in principle and practice. Doubtless this arises in some measure from individual circumstances, among them being water supply, quantity of work, and inventive capacity.

To mention the scores of contrivances in use would be more likely to confuse than instruct. The conditions sought after are, firstly, a steady supply of fresh water; and, secondly, means of syphoning, or otherwise conveying it away, after the prints have freely circulated therein. Two sketches are given to illustrate rapid and slow washing respectively.

The first of these is Marshall Wane's rapid cylindrical washer, described in "Studios of Europe," pp. 189-190, and shown in fig. 9. The outside cylinder, A, is simply a casing of tin to keep in the water; the inside cylinder, B, that revolves, is a few inches smaller than the exterior one, and it is simply a framework covered with twine netting. The prints are laid on this netting in the act of washing, the water being supplied by small holes pierced in tubes passing through the drum. Prints washed by means of this arrangement for

twenty minutes, after the previous treatment of four changes

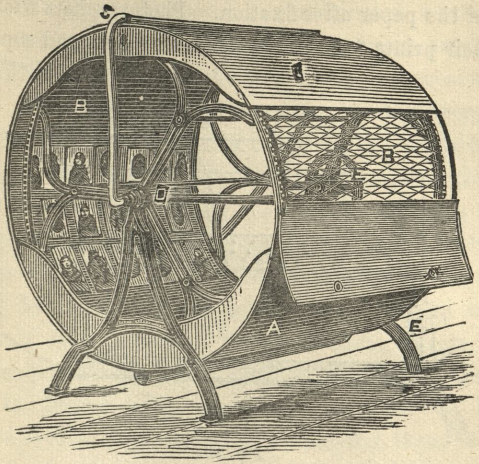

Fig. 9.

of water and pressing with the sponge, are not found to contain any trace of the fixing salt.

The other form is an effective arrangement intended for slower washing and larger quantities. It is an article of commerce from the design of W. Pitcher (fig. 10).

A, water supply. B, zinc cover to fit over C, perforated with holes finer than indicated in sketch, in order that the water may stream over the surface of the prints. C, deep glazed earthenware vessel for the reception of prints, a number of fine holes being made in the bottom for the water to pass through. D, outer vessel of the same material, fitted with syphon, S, to permit removal of wash water at regular intervals, dependant upon the rate of supply. Three or four hours' washing with this arrangement will be ample for eradicating every trace of salts which were retained in the

pores of the paper after fixation. Photographers who merely soak their prints for a dozen hours in water, and supplement

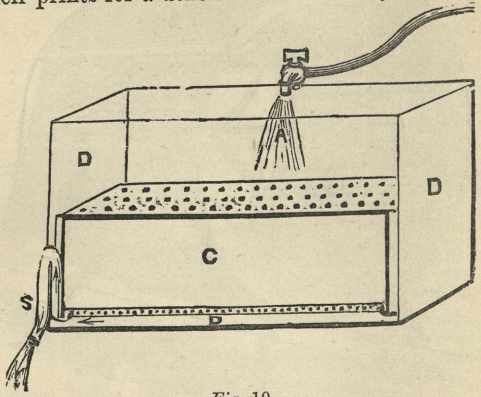

Fig. 10.

this treatment with one or two changes of liquid at the commencement, and as many at the finish of the soaking, cannot be said to efficiently eliminate destructive influences.

Blisters.—When there is a tendency for blisters to form upon the surface of prints, the cause is not infrequently due to drying the albumenized paper too hastily. The use of strong sensitizing solutions produce a similar result; so also do extremes of temperature in the solutions employed. In any case, one of the best means of minimising the evil, if not altogether preventing its appearance, consists in soaking the prints five minutes in salt and water, strength two ounces to the gallon, immediately upon removal from the fixing bath. The remedy is still more certain when an equal proportion of the fixing bath is mixed with the salt solution. Then the prints may be transferred to a plain salt and water bath, after which washing can be proceeded with in the ordinary way.

As the foregoing treatment has eliminated much of the fixing agent we desire to remove, the washing process may be somewhat curtailed, but the writer does not recommend it.

Hypo Eliminators.—To prevent the tedious operation of washing, it has been suggested to change the chemical composition of the salts left in the paper after fixing, and thereby destroy the property they possess in such a high degree of rendering the print evanescent. It has been shown by many chemists that this result may in a measure be attained by immersing the print, after fixing, in a dilute solution of lead nitrate or acetate, barium nitrate, *eau de javelle*, and common alum. As these eliminators are not so much in favour with every-day practitioners as with experimentalists, the method of employing them is merely indicated in order to open up a field for further research should the student desire to avail himself of it.

The lead solution is made by dissolving one ounce of lead nitrate or acetate in eight ounces of warm distilled water—two ounces of the above solution to each gallon of soft water will be found to be a workable proportion. A stronger solution will change the tone to a cold slatey colour, and a weaker one will not bring about the required decomposition. That such has taken place may be known by the solution becoming cloudy.

The prints should be immersed in the bath for the space of five minutes, keeping them constantly moved about as in toning and fixing. At the end of the time stated, remove them to a vessel of clean cold water, give them three changes in all, separating each time, when they will be ready for drying and mounting.

Although the above method has been included as a part of

the work in silver printing, the writer does not regard prints so treated as by any means permanent, and he has examples in his possession which go a long way to prove this statement.

Barium nitrate ($BaNo_32$) is used by adding two ounces of a saturated solution of the salt to each gallon of water. Use the same as lead nitrate or acetate.

Eau de javelle is made by boiling a mixture of dry chloride of lime and carbonate of potash in water. With three quarts of water mix half-a-pound of dry chloride of lime; dissolve one pound of carbonate of potash in one quart of water; mix the solutions, boil for fifteen minutes, and, when cool, filter for use. Four ounces of the above solution to each gallon of water will be a very good strength to use; treat in the same manner as lead nitrate or acetate.

Alum.—Make a saturated solution of ordinary ammonia alum; of this use four ounces per gallon of water, allow the prints to be moved about for ten minutes, then wash in several changes of water. Prints treated this way require to be soaked in water much longer, both before and after immersion in the alum bath, than by either of the other methods.

Alum is also useful as a preventative to the formation of blisters during washing, and prints which have been treated with it appear to have greater claim to the title permanent than the majority of silver prints.

Hypochlorite of zinc has recently been recommended in preference to other eliminators; it may be used in the same proportion as that given for *eau de javelle*

CHAPTER XII.

DRYING, MOUNTING, AND MOUNTANTS.

Drying Prints.—If we desire unmounted prints of large size, it is advisable to dry them as flat as possible, and thereby avoid cracks and tears. The superfluous water is removed by means of a clean linen cloth; two prints of the same size are placed back to back, and suspended by American clips in the drying room, but not from the clips used for the sheets of sensitized paper. When dry enough to curl at the lower corners, turn them upside down and leave until judged to be dry enough for flattening; this is achieved by putting the prints face downward, and keeping them so with a paper weight. Some photographers dry large prints upon a skeleton frame having shelves made of stout string. The prints are laid surface outward along the string, and, when nearly dry, are flattened as above.

Prints of small size may be suspended in strings of two or three dozen, one below another like steps, and when nearly dry, they will drop off; if they are collected and placed face downward under a weight, they will become flat and remain so.

Mounting.—Partly through photographic paper not being stout enough to withstand the wear most photographs are subjected to, and for other reasons, it is advantageous in the majority of cases to attach them to some kind of support termed a mount, which confers the desired strength, at the same time enhancing the value of such as a work of art; this process is called mounting.

There are several systems of mounting in vogue among

photographers, but they may be all classed under two headings, and for convenience we will call them the dry and wet methods. The first-named of these consists in drying the photographs as above, then applying some such substance as good starch paste in a manner calculated to give an even surface free from grit, hard clots, hairs, &c., and either attaching to the cardboard or other support immediately, or permitting to dry spontaneously, securing to the mount at any time afterwards that may be convenient—in which latter determination proceed as follows :—Pass a wet sponge twice over the cardboard mount where the photograph is to rest; place the print in the required position, and press it gently to ensure its retaining that position. Having done so, pass them both through a rolling press, which completes the process. The photograph should be uppermost, and the action performed quickly, to prevent any chance of tearing under the roller; one advantage this system has over others is, that no unequal expansion takes place in the print.

The second, or what we will term the wet system, may be briefly stated thus :—Each print should be placed separately, face downwards, on a clean wet linen cloth, the superfluous water being blotted off by the same; then the mounting substance applied to the backs of as many as can be conveniently managed—say three or four—after which they are placed in the desired position on the mount, and pressed down by means of a paper-knife and sheet of white paper; the process being repeated so long as any prints remain on the cloth. Whenever possible it will be found more convenient for two persons to do this work, one to apply the mountant, and the other to attach the print to its support; thereby reducing the chances of the albumenized surface

being touched with some of the mountant, provided both persons are equally careful. Should such a mistake occur, the excess must be removed immediately with a wet sponge, or the print will have a slovenly appearance, which may also interfere with the after-operation of burnishing.

Another plan is to transfer prints from the final washing water to a glass plate, albumen side being downwards (as many as fifty, or more, may lie on the top of each other without danger); and after squeezing out the excess of water the top print may then be brushed all over the back with some of the mountant, lifted by a corner, and placed in its proper position on the mount. It should then be rubbed down with a paper-knife until even, a piece of writing paper being placed between the photograph and knife during the rubbing in order to prevent scratches or tears. Apply some of the mountant to the next, and repeat until all are finished. This will be found a very convenient mode when only a few dozen are to be mounted.

Mounts.—There are several kinds of mounts. For instance, the cabinet mount, and the panel of thick cardboard, both of which provide only a small proportion of margin to be seen beyond the edges of the photographs; also the India-tinted, and other flat mounts, in two colours, which are usually of less substance, and exhibit wide margins around the photograph. The latter is mounted in the centre of the cardboard, and abuts upon an inch or two of pale buff or neutral colour; outside this tint a grey or white margin surrounds the whole. There are also plain, imitation flock, and cut-out mounts, besides many others; but these are enough for illustration. All the mounts mentioned, except cut-out mounts, are intended to receive the photograph on the surface. They

should be so attached that no air spaces can be observed when examined; neither ridges, lumps, nor traces of the mountant should be seen on the surface or margin.

Cut-out Mounts.—Oval, dome, and other shapes, are often cut out of thick cardboard; the photograph is glued, or otherwise fastened at the back, thereby giving an effect of distance. The plan is only resorted to when photographs are to be framed. The photograph must be previously mounted on cardboard, rolled or burnished; in fact, finished before it is thus attached to the cut-out mount.

Mountants—Starch.—For various reasons it is probable that no better mountant is used for attaching photographs to substances such as cardboard than a good starch paste, made by mixing Glenfield's, or any other good class of cornflour starch, with a little cold water until a very stiff paste is obtained; then add *boiling water* (stirring vigorously) until a clear paste results. Should the paste not be of a good consistency—viz., rather limpid—discard it, and make fresh, using a little less cold water in mixing with the dry starch; and be sure the heated water to be added is at a temperature of 212° F.

Dextrine and Starch.—Two ounces of dextrine mixed with half-a-pint of cold water, added to the above starch paste in equal proportions, the mixture being heated on a water or steam bath to 212° F., makes a strong and useful mountant for photographs; it is an excellent adhesive, is not easily affected by moisture, and more useful for mounting photographs in scrap books than starch alone.

Glue.—Thin glue, free from grit, is largely employed by professional mounters; it requires to be used sparingly, and dexterity is essential. A small quantity of carbolic, salicylic,

or other antiseptic should be added. A good plan is that of gluing the surface of a slab, then lay the back of the photograph to be mounted on this layer of glue. Pick it up, and adjust in position on mount, then rub down as usual.

Gelatine.—A solution of gelatine, 1-8, is also much used for the purpose, especially in America; but it is open to an objection that glue is not free from, viz., the proportion of gelatine or glue to water must be sufficient to obtain a strong jelly when cold, therefore it must be liquefied on a water bath each time it is required for use, and the oftener it is heated, the more will it lose its adhesiveness. But this is not the chief obstacle. Gelatine is more or less affected by the atmosphere, and from its nature absorbs a great deal of moisture; it is highly probable that much of the fading of silver prints experienced of late years, while much older prints are unimpaired, may be due to the use of gelatine or glue without an antiseptic as a mountant.

Now let us suppose that the prints are of cabinet size, to be mounted on ordinary cabinet mounts, not reduced to the required size before toning, and we have decided to cut them by means of the glass-shape and sharp knife, as described in a former chapter: under these circumstances the prints must be dry, and the cutting-shape held down firmly on the print to obtain the best result. To mount, place six, albumenized side downwards, on a clean and damp linen cloth, pass a brush well charged with starch paste over each, separately, working from end to end, and from side to side, being careful not to get any starch underneath, or leave any lumps or extraneous pieces on the print; have ready at hand a pile of mounts, some sheets of clean paper, a paper-knife, and a damp sponge. With the paper-knife raise the first starched

print from the cloth, adjust it over, but not touching the mount, until the margin appears equal along the top and two sides; now lower the top edge on the mount, and gradually the remainder. If this has been successfully accomplished—which may be seen at a glance—cover with white paper, and rub the print well down all over with the paper-knife. Should any of the mountant be squeezed out at the edges, it should be removed with the sponge. When the whole of the prints have been mounted, place them, face downwards, on a clean surface in a current of air; they do not alter in shape so much this way as when left to dry face upwards. To prevent the photographs from curling inwards, C. Keuchel constructs grooved wooden slabs or strips of moulding having a section, as shown in fig. 11, each slab being a trifle over

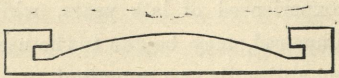

Fig. 11.

two feet in length. The mounts are pushed into this grooving, six, end to end, so that they become arched. After mounting they are again slid into the grooving, and allowed to remain until dry, when they are in the best condition for rolling.

Rolling Press.—The subjoined figure 12 represents a rolling press having a polished steel bed, over which an adjustable roller traverses. Pressure is regulated from above, as shown in the sketch. Previous to rolling a photograph, the surface should be wiped with a silk handkerchief to remove particles of dust or paper; place the print, albumen side in contact with the steel plate, and turn the handle sufficiently to pass the print twice through the press, which

flattens the picture, and should produce an evenly polished surface. By heating the plate a more brilliant surface can be obtained.

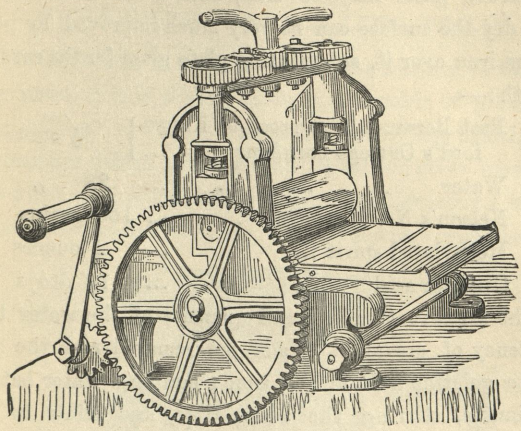

Fig. 12.

When rolling is not permissible, as in the case of mounting

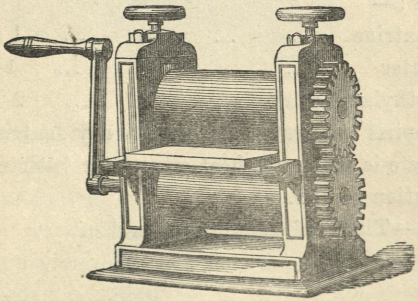

Fig. 13.

photographs in books, the print may be attached to the leaf of the book with a mountant, such as fish glue containing

very little water. Damp the back of the leaf with a wet sponge, set aside to dry with stout cardboard on each side of the leaf.

A strong paste may be used, such as the following, and when dry the surface can be very much improved by passing a warm iron over it, substituting plate glass for the cardboard beneath:—

Best Bermuda arrowroot, or Kingsford's Oswego cornflour ...	3½ ounces
Water	28 ,,
Nelson's No. 2 gelatine	160 grains
Methylated spirit	2 ounces
Carbolic acid	12 drops

Mix the arrowroot and a small quantity of the water to the consistency of cream, then add the remainder of the water and the gelatine a little at a time; boil on a water bath for five minutes, stirring the whole time, and allow to cool; before quite cold, add the spirit and carbolic acid. This mixture will keep a long time if well corked.

Another:—

Dextrine	1 ounce
Water	1 ,,
Methylated spirit	2 ounces

Mix the spirit and water, stir in the dry dextrine, until a smooth paste is obtained; heat on a water bath until a clear brown solution results.

Another.—Thick solution of gum-arabic.

CHAPTER XIII.

BURNISHING, ENAMELLING, ETC.

The burnisher acts in a somewhat similar manner to the hot rolling press, but in skilled hands it is capable of producing a more brilliant surface and warmer tones. The principle of the burnisher differs only from the hot rolling press inasmuch as the print is dragged by a roughened roller over a highly polished and hardened steel bar, which is stationary and heated,

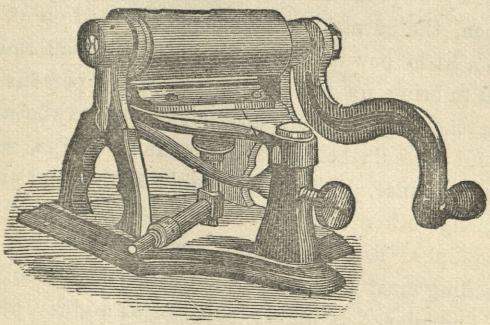

Fig. 14.

with a Bunsen gas burner or other means, Fig. 14, instead of passing between two polished steel rollers, or a steel bed and rollers, as in Fig. 12.

To ensure success with the burnisher, it is necessary to lubricate the photograph, and there are several ways of doing this. Perhaps the highest degree of polish is obtained with curd soap rubbed on in the dry state by means of a flannel pad. Some operators prefer using an alcoholic solution of

soap made by dissolving sixty grains of curd soap in a small quantity of water, adding methylated spirit to make twenty ounces. Moisten a tuft of cotton-wool with the soap spirit, and rub the surface of the photograph on every part; five minutes afterwards it may be passed through the heated burnisher; but the tool must not be hot enough to scorch the photograph, neither must a halt be made while it is passing over the heated bar, or the work will be spoiled.

It is also necessary to prevent particles of dust entering beween the bar and the photograph, or scratches will most certainly be produced on the subsequent prints. Should this happen, the burnishing tool may be rubbed on an oil stone, with a little powdered emery, finishing on an emery knife-board to bring up the polish. As many persons object to using soap in any form on photographs, wax may be substituted, a useful formula being solid paraffin 20 grains, methylated ether one ounce, dilute with benzoline spirit one pint.

Among other modes of obtaining glazed surfaces on photographs besides rolling and burnishing, so-called enamelling must be mentioned, the finished result giving a very fine glaze, as highly polished as a glass plate. The process consists in placing the albumenized surface of a photograph, in a moist condition, in contact with a polished glass plate which has received a coating of normal collodion, and a somewhat dilute solution of gelatine; when dry the prints will drop off. The following details, if carefully pursued, are reliable:—

Transparent gelatine	1	ounce
Water	8	ounces

soak one hour, then add—

Glycerine	10	drops

heat on a water bath until the gelatine is dissolved; filter while hot.

Normal Collodion.

Pyroxyline	2	drachms
Methylated ether	8	ounces
Methylated alcohol	2	,,

These proportions may be altered to suit the cotton used. Mount the photographs by means of gelatine, as above, on thin cardboard; the kind known as Bristol board being very suitable. When quite dry, touch out any white spots which may be caused by dust during printing, or faults in the negative; afterwards place the mounted prints in a dish of cold water to soften the board. This will take place in about ten minutes more or less. The prints should remain until quite soft, as success depends in a great measure on their pliability at this stage. The time that elapses while the mounted prints are drying may be occupied in preparing the plates. Patent plate free from imperfections should be cleaned with dilute nitric acid, well washed, and polished with tripoli, or any of the substances usually employed for plate cleaning; powdered French chalk (talc) is dusted on the surface, and removed with a polishing cloth. Pass a camel-hair brush over the plates to remove particles of dust, then coat with normal collodion in the same manner as coating a wet plate or varnishing a negative; when set, rear on end to dry. A number of plates may be coated, as they will be none the worse for keeping.

We will suppose the mounted photographs have been soaked as directed, and are soft; remove them from the dish of water to a clean damp cloth; blot off the excess of water,

and leave them in the cloth until they are required for the next operation.

The gelatine should be re-melted in a flat porcelain dish over a water bath; into the solution immerse one of the dry collodion plates, and one of the photographs from the damp cloth. To bring these two into perfect contact requires a little skill and practice. From the description, however, it should not be found at all difficult. With the left hand hold the plate, collodion side uppermost, just under the surface of the solution; with the right hand lower the print gradually on to the plate, commencing at the bottom, and working upwards. The top of the print should be held outwards, so as to form a slight curve; by this means it will be easy to see the air-bells gradually pushed out as the two surfaces come in contact. Having accomplished this satisfactorily, lay the plate down on the bench, and well squeegee the back of the photograph to remove any excess of gelatine and air imprisoned in the paper. When all the prints have been squeegeed down on their respective plates, place them in a current of dry air, and leave them for twelve hours; at the end of that period the prints will probably have dropped off the plates; if not, they will come away quite easily if the point of a penknife is passed round the outer edges to give them a start. It is not usual for photographers to deliver these so-called enamelled photographs to their clients in this condition; they are generally stamped up by an embossing press. The margin, after being reduced to the required size (prints intended for enamelling need not be cut until after they leave the glass plate), is fastened with glue to an ordinary thick card mount. When cabinet or larger sizes are produced, the air space between the embossed print and the

ordinary mount should be filled with cotton-wool padding, to prevent the centre sinking by reason of changes in the atmosphere. It will be seen that the highest degree of finish can be obtained by this method. Pictures printed as cameo vignettes, medallions, and cushion-shapes, with printed-in margin, as described in a former chapter, are particularly suited to this class of work.

Fig. 14 illustrates three forms of embossing press. The print is adjusted so that when pressure is exerted, the metal die fits exactly over the mask line selected in printing; that is to say, an oval used in printing should be of the same dimensions as the die of the embossing press. Do not apply too much pressure, and immediately remove the print, for unless the cardboard be of unusually good quality, it will in all probability burst. Many inexperienced persons fall into error in this particular, and throw the blame on the press or the cardboard. To avoid such failures, allow the print to remain under less pressure for a longer period, say one or two minutes.

Photographs enamelled as above, or mounted in optical contact on glass, as described in the next chapter, require special treatment for the removal of white and other spots caused by dust in printing and imperfections in the negative. Water colours may be used for the purpose, provided the medium cannot be easily removed by water. Such a substance we have in spike oil of lavender. For white spots, mix India ink, Indian red, and neutral tint with spike oil of lavender to the consistency of cream; test it for shade of colour by touching out a white spot. Use a sable brush with good point. Let the brush be charged freely with colour, and then worked nearly dry on the palette; by adopting this

measure, beginners will soon be able to touch prints successfully, an achievement not attained when the brush is

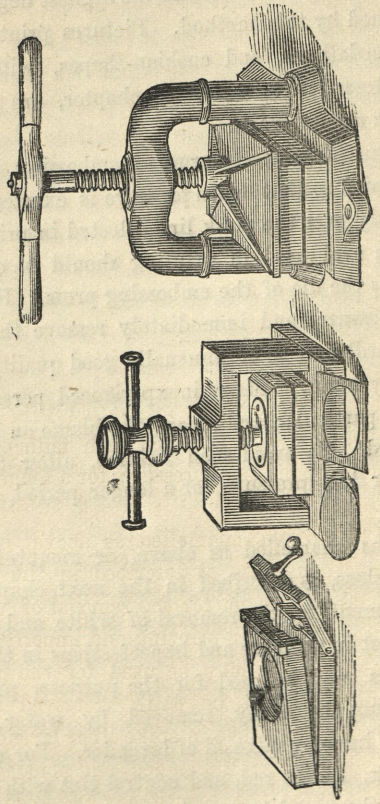

Fig. 14.

loaded with colour. In the latter case, the tyro would take out a white spot, and put in a black one—a circumstance sometimes met with among experienced spotters. If the

colour is the same shade as the photograph, then proceed to remove all the white spots, levelling them carefully into the surrounding parts. Dark spots may be lightened with Chinese or zinc white and Indian red mixed with spike oil as before. All the working up that is intended to be put on the print should be done after mounting, and before soaking in the vessel of cold water. Another vehicle is sometimes used for mixing the colours, viz., gelatine containing a small proportion of chrome alum, to render it insoluble. And yet another which has been advocated is undiluted egg albumen. When the colour is dry it is covered with strong alcohol, which possesses the property of causing the colour to stick well during the soaking process.

CHAPTER XIV.

ENAMELLING (*continued*)—MOUNTING ON GLASS, METAL RIMS, ETC.

THERE are other methods of obtaining enamelled surfaces, differing from the foregoing, inasmuch as the vehicle, gelatine, is dispensed with in one, and both gelatine and collodion in another. In the former case, the glass plate is coated with wax in one of its solvents (either benzoline spirit, or methylated ether will do); over this the plate receives a film of plain collodion in which the solvents are about equally proportioned. Thus:—

Pyroxyline (Hopkin and Williams)...	¼ ounce
Methylated alcohol	10 ounces
,, ether	10 ,,
Castor oil	20 drops

Moisten the cotton with 2 ounces of alcohol, then add the ether. Finally add the remaining 8 ounces of alcohol, in which the castor oil has been previously dissolved. When set, it should be washed in cold water until, when water is poured on, streaks and greasy lines have disappeared.

Unmounted prints previously soaked in water are to be placed wet in contact with the plate, in the same manner as described above, water being the vehicle this time instead of

gelatine. Upon examining the front, no small spots should be visible, said spots being air-bubbles. Cover the back with two thicknesses of note-paper, or one of American cloth; squeegee thoroughly, and set aside to dry. The other plan, which dispenses with both collodion and gelatine, was suggested to the writer by his friend, Robert Offord. The following details will illustrate the simplicity of the process. A glass plate is well polished with tripoli or one of the usual plate-cleaning substances. It is then dusted over with finely-powdered French chalk, the talc being formed into a pad with flannel to do the polishing. The plate should then be immersed in a vessel of water. A well-soaked print, placed in contact with the plate as previously described, will adhere so long as moisture be present; when dry, which may happen in the course of an hour in a warm room, the print will drop off. Prints treated with collodion alone may have mounts attached to them by means of starch, glue, or gelatine, by brushing the mountant on the mount and print, and when rubbed down in contact, put under pressure for an hour. But when neither collodion nor gelatine is used, as in the last method, the plate requires to be coated with some suitable substance on the talc, to prevent the print sticking fast to the glass. If it be desired to attach a mount, alcoholic soap solution, used for burnishing, will answer the purpose effectually, thereby preventing the mountant permeating through to the glass.

Mounting in Optical Contact.—A quarter of a century has elapsed since the recommendation was made to attach silver prints in optical contact with glass plates, for the purpose of vastly increasing the translucency of the shadows, and general purity of tone. All who visit exhibitions must be

familiar with this class of work; as its popularity is in the ascendancy, the following details may prove of interest. Choose unmounted photographs which have been printed rather darker than for mounting on cardboard, and it is better to select those which have been undertoned, as there is a tendency for the colour to become more blue when finished. Take a plate of glass, free from scratches or blisters, and carefully polish with rouge, tripoli, or any other suitable polishing mixture. Heat the plate on a water oven, or before a clear fire, so long as the heat can be comfortably borne when applied to the back of the hand. Remove particles of dust with a camel-hair brush, then pour a pool on the centre of the warm plate, of the following hot gelatine solution filtered—one part French gelatine to fifteen parts of water—which must be equally distributed over the entire surface by means of a glass rod. The print, by preference slightly smaller than the sheet of glass, and which has been soaked in a weak solution of gelatine—one part of gelatine to forty parts of water—is laid albumenised side downwards on the gelatinised glass plate. The excess of gelatine should be removed with a squeegee, and when dry is complete. The plan is excellent for use in show-cases out of doors, as the photographs last very much longer; but it should be observed that there is a danger of the print becoming detached after a little while when the plates have not been scrupulously cleaned.

Medallions in Metal Rims.—Another phase of mounting photographs in optical contact may be seen in the medallion style, which usually takes the form of an oval photograph, on an oval plate of glass, some two or three inches larger than the photograph, the extra size being used for the pur-

poses of a jet black margin. Proceed as follows:—The temperature of the work-room is important, and success or failure depends very much upon it; 65° F. answers well for coating and drying room, and necessary precautions should be taken to obtain that condition. The following articles will be found useful. A flat tin dish for the purpose of dissolving the gelatine, arranged over a Fletcher atmospheric gas stove; a similar dish for soaking the prints in melted and filtered gelatine; a lipped jug for pouring the solution over the glass plate, supported above a fine gas jet, giviug sufficient heat to prevent the liquid cooling; a wedgewood funnel plugged in the neck with wet sponge; a glass rod for distributing gelatine over the plates; a carbon printer's rubber squeegee; a piece of American cloth to interpose, while squeegeeing; strips of wood an inch broad, and any length, two such strips joined by cross pieces forming racks for drying; a stock of metal rims and glasses to fix; padded blocks of the size and shape to fit glasses (the pad is used as a cushion to support the glass while a burnishing tool is being used to fasten the rim); a bottle of Bates' dead-black varnish, and Young's patent size as sold by oilmen.

Melting the Gelatine.—Cover the bottom of one tin with size broken into small fragments, and just cover with cold water. Raise the temperature to near 200° F., to effect perfect solution, then filter through sponge, and divide into two parts, one for the dish in which the prints are soaked, and the other for the jug to be kept hot in the manner above stated.

Mounting.—A well-polished plate is heated to 100° F., levelled, and covered with a pool of hot size. Transfer a soaked print from the dish of hot size to its position face

down upon the coated glass plate, and roughly squeegee; remove excess with a wet sponge, and again apply the squeegee, this time interposing a piece of American oil-cloth. If air-bells are not visible when examined from the front the mounted photograph is placed, paper uppermost, upon the rack to dry, which will occupy at least two hours. When dry, the back of the photograph is coated with size, and again left two hours to dry. When the second coating is quite dry, a brush well charged with Bates' black is passed round the margin, completely covering the glass, but not overlapping the photograph more than really necessary; thirty minutes' drying will remove tackiness, and no more remains to be done beyond fitting the back, adjusting the metal rim, and securing it neatly with a burnishing tool on the padded block. Photographs vignetted to the full extent of the plate appear effective when mounted as above, in which case black varnish is dispensed with, there being no margin of clear glass. By sand-papering some of the paper from the back (as in crystoleum) a certain amount of colouring may be done with aniline dyes in alcohol with good effect; the main difficulty is securing a proper depth of tint.

CHAPTER XV.

ORDINARY SPOTTING, WORKING UP, ETC.

Spotting.—Let it be thoroughly understood that spotting does not mean the substitution of a white spot in a print—no matter how caused—for a black one; but the removal, by means of water colour, of all objectionable spots, lines, patches, or inequalities.

This process may be applied before or after rolling, if that mode of finishing be adopted; but many prefer to do spotting first, in order that, when finished, the surface shall be equal, or, in other words, the dull marks caused by the spotting-out brush will not show. The same may be said in the case of burnishing; but if the burnisher is used very hot, the touching colour will become a shade warmer than the photograph, necessitating its removal. As the print in such a case would require re-spotting on the burnished surface, with a suitable colour to match the tint of the photograph, obviously, the time occupied in the first work would be wasted; therefore one or two trials should be made to indicate the shade of colour necessary to match prints of any particular tone. It is easier to touch out a spot on an unrolled print, on account of the surface being more spongey.

Among the most suitable colours to employ are Indian ink, Indian red, and neutral tint, mixed with dilute gum-water

or albumen, until the desired tint is obtained. Ivory black may be added if required. For warm-toned photographs Indian red should predominate; whereas, blue or grey-toned photographs require a larger proportion of neutral tint. The lakes, although useful for obtaining exact shades, are not sufficiently permanent, therefore had better not be used; all that is necessary can be easily done by means of the above mixture. Commence by lightly stippling out a white spot in the half-tint, using only the point of a small sable pencil charged as previously described for the purpose, Chapter XII. When finished, it should be difficult to detect where the spot existed; but if it is visible, and just a trifle lighter, it may be remedied by one or two light touches of the brush, after taking up the smallest possible quantity of colour from the palette. On the contrary, if the spot is easily discerned by being darker than the surrounding portion, remove it entirely, and start afresh. Patience is absolutely necessary if one wishes to spot prints well, for it is certainly a tedious operation; therefore, persevere with the first spot until perfection has been attained, then all the others will become easier.

Next to spots, it may be necessary to subdue a prominent light, which we will call a patch; when small, stipple in with the point of a brush slightly charged with colour; but when the patch to be worked on is large, cross-hatching will be found quicker and better. Charge the brush with colour, and make short strokes in the same manner as the down strokes of a pen, commencing at the top with three short strokes, crossing these with two in the opposite direction. Proceed in this way until the patch has been covered; when dry, stipple lightly between the short strokes by

means of a fine-pointed brush containing very little colour, until the whole is perfectly levelled. Black spots may be covered with white slightly toned down with ordinary touching colour. Working up to almost any extent may be performed by persons possessed of the necessary taste and skill. Shadows can be strengthened with ivory black mixed with gum water; lights may be worked over with white, toned down with Naples yellow, and such a mixture is very useful for touching up the pattern of white lace and light trimmings generally; the middle tints may be stippled with ordinary touching colour, and where needed, such as the shadows in the face, a mixture of black and white.

Whether spotting is done before or after rolling or burnishing, an encaustic paste is useful to have ready for several reasons. Dull spots caused by extra touching, or by finger marks, may be easily removed, the surface becoming brighter than with burnishing alone. What is of greater importance, however, is the permanence it is said to confer; for a very reasonable contention is, that when the pores of the paper are filled with wax, the photograph is protected, to a large extent, from atmospheric influences.

Encaustic Paste is essentially bees'-wax reduced to a paste with one of its solvents, such as turpentine. A good working strength being:—

Bleached wax	1 part
Turps	4 parts

Dissolved by gently heating on a water bath; when cold, it is ready for use. If the smell of turpentine is objectionable, one ounce of spike oil of lavender may be substituted for a similar quantity of turpentine: the result will be the same.

Apply the paste to the photograph by means of a small piece of flannel, rubbing it lengthways, but all over; then work in a circular direction, using the same flannel, until the wax appears to be all rubbed into the print. Make a pad of clean flannel, and lay on the friction for a few seconds, working as before in a circular direction; if you get tired, don't make a halt on the print, or it may cause a mark; if the polish is not satisfactory apply more wax, and repeat the process, finishing with a clean piece of old cambric.

Adam-Salomon Formulæ.—

Pure virgin wax	500 parts
Gum elemi	10 ,,
Benzole	200 ,,
Essence of lavender	300 ,,
Spike oil of lavender	15 ,,

Melt on a water bath, mixing thoroughly, and strain through muslin; or the gum elemi may be dissolved in the solvents, and the melted wax added after filtration; to make it thinner add a little more essence of lavender.

John L. Gibon, in his "Photographic Colourist's Guide" (E. L. Wilson, Philadelphia), recommends the following mixture for the purpose of *judiciously* enhancing the transparency of shadows in a silver print:—

Gum-arabic (well picked and of good quality)	1 ounce
Water	6 ounces
Rock candy	2 drachms
Acetic acid	20 minims
Alcohol	20

He says:—"Do not be alarmed at the idea of this modicum of acid being allowed to touch the surface of your photograph. I have never yet known an instance of this combination affecting in any way the silver print. The gumming must be accomplished by clean, decisive strokes of a moderately-filled brush. It is here, more than in any other case, that I warn you against repeating your wash upon a surface already wet. Should you persist in it you will produce what I call 'smudge.'"

CHAPTER XVI.

RETOUCHING NEGATIVES.

Although retouching is hardly within the domain of silver printing, it so often falls to the lot of printers to put whatever work is done upon negatives which come into their hands, that a chapter of guidance, if only of a cursory character, will no doubt prove acceptable. At the same time, it must be observed that beyond giving a mere outline of this important branch of photography, little will be said, as special works are devoted to the subject.

When a negative is finished, it is seldom in a fit state for printing; transparent spots require filling up to the same density as the surrounding parts, clouds need strengthening, water-falls or waves are not vivid enough, foliage is imperfect, the modelling in the flesh parts of portrait negatives is too abrupt, freckles abound; these, and many other defects likely to mar the beauty of the resulting print, may be corrected by skilful retouching. Since the general adoption of gelatine plates these defects are, in a measure, not so glaring as formerly; but we have to contend with some of them even now, in a less aggravated form. Graphite, commonly but wrongly named black-lead, is the agent employed to overcome many of the difficulties, and by its judicious use very fine results are obtained.

To facilitate the work of retouching, a suitable frame or easel will be found a great boon, especially when adjustable, as in the following sketches, arranged to suit the comfort of the

worker, but a less useful and more primitive contrivance can be obtained by fixing two struts to a large printing frame,

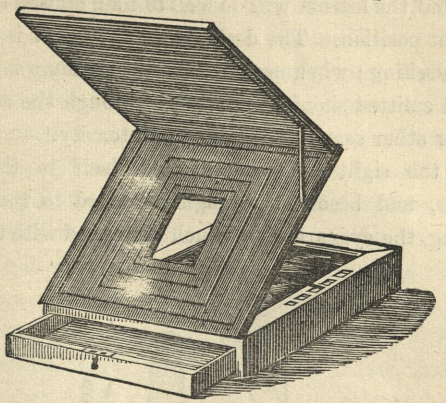

Fig. 15.

and standing it obliquely on a table facing a window. In

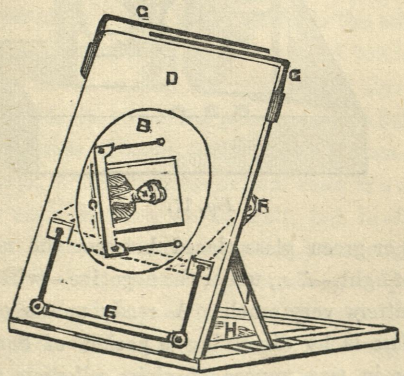

Fig. 16.

passing it may be remarked that cramped, leaning-forward positions, adopted by some retouchers, tend rather to deterior-

ate health than promote it; therefore, bearing this important fact in mind, the learner will do well to train himself to work in an upright position. The desk shown in Fig. 17 is for day or evening working; when used in daylight the lamp is removed. The light emitted should be diffused through the medium of an opal or other screen, according to intensity.

Until the sight can accommodate itself to the altered conditions, and become thoroughly trained to the work of retouching, the eyes are often much distressed with the strong

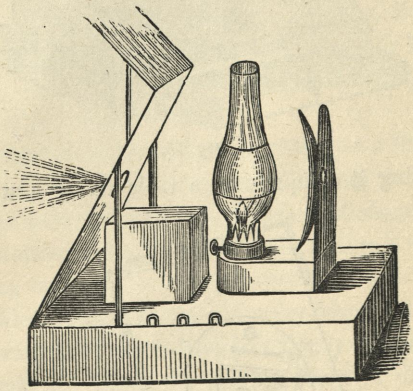

Fig. 17.

light; blue or green glass placed between the negative and the source of light—*i. e.*, under the negative—will be found to improve matters very much. A ready means of obtaining coloured glass is by dissolving a packet of Sand's penny aniline dyes in two ounces of plain collodion, or negative varnish. Coat the piece of glass as in varnishing; dry, using very little heat. The finest result is obtained when the dye is dissolved in collodion, but the most durable when dissolved

in spirit varnish: the glass plate should be collodionized previous to coating with dye. Another help to sight, from which great comfort is derived, is a small oval opening in brown paper, of such a size that every part of the negative is covered except that being worked upon; the amount of light through such an opening, previously filtered through blue glass, will not distress the eyes very much. Besides a retouching frame, the following articles will be needed:— Finely-powdered graphite (such as electrotypers use will be found the best); an artist's stump, for applying the graphite over large surfaces that may require it; *papier mineral* or tracing paper; an assortment of drawing pencils, best quality— soft, medium, hard, and very hard; a few finely-pointed sable brushes, small size; cakes of water colours, among them Prussian blue, Indian ink, vermilion, Chinese white, and carmine; a bottle of gum water, containing three drops of glycerine per ounce; gum being added to the colour when it is desired to stipple on varnish mediums. A bottle of medium, for use either before or after varnishing, will also be useful in order to facilitate the bite of the pencil. Canada balsam, diluted with two volumes of turps, forty grains of gum-dammar per ounce of turps, or eighty grains of gum resin in a similar quantity of the same solvent, works well; but in either case the addition of a little camphor (10 per cent.) as a toughening agent is beneficial. To use, moisten a piece of rag with the medium, and, when nearly dry, pass it over the parts of the negative required. A medium is also useful in removing the marks of the pencil when the retouching has been imperfectly done, at the same time leaving a good surface for the new work to be laid on. Some photographers use an abrading medium such as cuttle-fish bone, powdered resin (alone, and with

dextrine), fine emery, putty powder, and other cutting substances, the object being to obtain a matt surface presenting a good tooth or bite to the pencil. The mode of application is to take a little of the dry powder on the finger, and rub the part to be retouched with the powder in a circular motion until a matt surface results. Work put on this matt surface cannot be removed so easily as in the case of turpentine, which is recommended in preference to the others. We attempt the correction of the defects in the order enumerated above.

Transparent Spots.—When these are small, and the negative varnished, fill up with a hard pencil, HHH, having a good point. When the varnish refuses the pencil, resort to a touch of medium, and try the pencil again; large spots can be filled up more easily with water colour, using carmine or vermilion, until the density of the surrounding part is attained.

Skies.—Strengthening of clouds can be done on the varnish, using the stump and powdered graphite. When more work is needed than can be done with the stump, Indian ink, rubbed up with gum water, and applied with the brush, will answer, or the back of the plate may be coated with equal parts of gold size and turpentine, and when nearly dry, stump the portions necessary with graphite. The highest lights, when not strong enough, in studies of waves, waterfalls, sails, &c., may be improved by the same means.

Papier Mineral and tracing papers are useful for gumming on the back of those portions of a negative which print too pronounced, and in cases of under-exposure the back of a negative may be entirely covered with this material; when necessary, both pencil and stump being freely used either

on the negative or paper, or both. In this manner the printing power of natural clouds can be augmented.

Foliage.—When negatives of foliage lack sufficient detail, it may be supplied in a measure by marking it in with a soft pencil, such as BB. Shadows which print too darkly are better treated with *papier mineral*, coloured dyes, or stumping with plumbago, whereby they are sufficiently protected during printing.

Portraits.—Modelling the flesh portions in portrait negatives requires a good deal of skill to obtain the best results; and when the negative is of value, it will be better to put it in the hands of a professional retoucher, than to run the risk of spoiling it by inexperience.

Before commencing to retouch a portrait negative, a silver print had better be taken off, and any shadows or marks considered objectionable noted, and spots, if any, removed as above. We then proceed to minimize or take out freckles and skin markings with the point of a pencil, which appears best adapted to the particular surface under treatment. This done, the negative should for convenience of working be so fixed on the easel that a pencil not too sharply pointed may freely traverse with a scumbling motion over the deepest shadows, lines, and wrinkles without crossing, or interfering with the lights; these latter are next added where requisite, or strengthened as thought necessary; the whole may then be smoothed a trifle to destroy the effect of harshness, but further than this it may not be safe to attempt. Another method, after softening inequalities noted in the proof, is to make a system of short strokes throughout the face, commencing with the highest light in the forehead,

and supplementing these with a series of intersections where thought needful, and in some cases filling up the interstices to form lights. The touch should as a rule be light, or there is a danger of those unaccustomed to the work dragging the pencil into lumps, and perhaps digging holes in the film.

When one uniform touch has been maintained throughout, without destroying the force of the lights or half-tones, simply raising them a degree, at the same time removing the objectionable parts, another print may be taken and compared with the first, after which any necessary alterations may be made; the other flesh parts—viz., arms, hands, &c.—are treated in a similar manner to the face.

As it is not possible to name any particular pencil, it will be better to try one of medium hardness, such as H H; and if that does not suit the varnish, try another. The same remark applies also to negatives worked on retouching medium, or on unvarnished films.

From under-exposure detail is often wanting in the hair and draperies; this may be supplied in the same manner as suggested when dealing with foliage. Lace usually requires strengthening in the lights, and for this purpose the pattern should be traced either with a soft pencil or a brush charged with Chinese white.

Waterfalls, rapids, lakes, and a variety of subjects sometimes possess excessive density in patches when received by the printer. In addition to the methods suggested for overcoming the difficulty in Chapter VII., there are others of a chemical character, such as "Farmer's" ferricyanide reducer, which scarcely belong to the printing department, and those of a mechanical nature, often resorted to by

retouchers. The latter include cutting mediums, turps, and alcohol, which reduce opacity to any extent locally, when applied with plenty of friction. For instance, dip a piece of rag in strong methylated alcohol, and rub the dry surface of a gelatine negative briskly; pretty soon some of the black silver deposit will be found on the rag, and of course density in the coresponding portion of the negative will be thereby lessened.

CHAPTER XVII.

COLLECTION AND TREATMENT OF RESIDUES.

It may safely be assumed that those whose printing operations necessitate the employment of a very limited quantity of material, are not much concerned whether seventy-five per cent. of the expensive metals used are recovered, or a somewhat less proportion. The professional printer, who probably purchases upwards of a hundred ounces of silver nitrate every week, takes care it does not return in wholesale quantities to mother earth if he can prevent it, and consequently adopts methods more or less perfect to secure that end. Into the details of these it is not necessary to enter, as sufficient justice can be done to the subject by setting forth one reliable plan for the recovery of silver and gold. At the same time it appears advisable for all busy workers who have not time and the convenience at their disposal to collect the residues from the first washing waters, gold toning, and fixing baths respectively, and forward each on to the refiners in separate parcels.

Paper Cuttings, etc.—Commencing then with the contents of section F, fig. 1, designed for the reception of cuttings from sensitised paper, waste prints, and blotting-paper which has been used for soaking up any nitrate of silver solution that may have been spilt, also old filtering papers that have done service for silver solutions. These should be burnt in an ordinary shut-up stove which has been previously freed

from cinders, fine dust, and ashes, &c. Very little should be burnt each time if the draught of the stove is great, because, by creating a fierce fire, a loss of silver will be sustained, on account of paper containing silver passing up the chimney. When small quantities are to be burnt, an ordinary flower-pot may be filled with paper-cuttings, and ignited from the top; the fire will consume the whole of the paper if the pot is placed in a good current of air. When the paper is all consumed, and the stove or other contrivance has become cold, the ashes may be collected, either for further treatment at home, or to be disposed of to the dealers in photographic residues, who have every facility at their command for the economic recovery of the metals contained therein.

The further treatment of the paper ashes consists in mixing them with one-fourth their weight of sodium carbonate, and heating up in a crucible; after the moisture has been driven off, the crucible should be removed from the fire, and one-fourth part of potassic nitrate (nitre) added, together with a small lump of sodic biborate (borax); heat again, and the silver will run down to the bottom of the crucible. Supposing only papers used for silver solutions have been treated, the metal button at the bottom of the crucible will consist of pure metallic silver, which only requires dissolving in strong nitric acid, and evaporating, to obtain crystals of silver nitrate pure enough for further use; or the crystals may be again dissolved and recrystallised until the highest possible degree of purity is reached.

Washing Water.—In Chapter X. it was directed that a suitable jar be provided for the collection of the washing waters used for soaking the prints previously to toning them, also the rinsing waters from cleansing the sensitising dish,

and silver bottles. This water being the most valuable of any of the residues, care should be taken to save it, and, having saved it, to extract all the silver from it.

Among photographers it is customary to add sodium chloride to the vessel containing these washing waters, and after allowing twenty-four hours for the precipitate to subside, the supernatant liquid is poured or drawn off to make room for the next lot of washings (see section of residue tank, fig. 18).

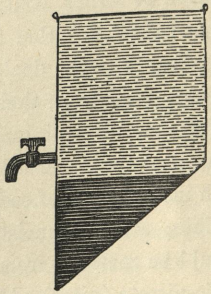

Fig. 18.

The late H. Baden Pritchard, who was certainly the most practical writer on photographic subjects in his time, wrote of this tank, page 196, "Studios of Europe," as follows:—"The tanks are placed in the open yard, in the full glare of daylight, for they (Valentine and Sons, Dundee) find the deposition of the chloride takes place much more rapidly out of doors than in. In summer the deposition is very rapid, while in winter it is comparatively slow; but still there is no danger of losing suspended particles by drawing off liquid that has stood twenty-four hours in their tanks. . . . . The bottom of these is wedge-shaped, so that when emptied of liquid the residue cannot be carried off."

The action which takes place is simply this. The water may be considered to contain silver carbonate, silver nitrate, and silver chloride. The two former, when acted upon by sodium chloride, form sodium carbonate and nitrate (soluble in water), and silver chloride (insoluble in water), which, being a heavy flocculent precipitate, falls to the bottom of the vessel, and remains there. If too much sodium chloride is added, a portion of the silver chloride formed will be re-dissolved; and if an insufficient quantity has been used, some of the silver will remain unconverted, and will be poured off with the supernatant liquid and lost. Hydrochloric acid is a much better agent to employ, because it is not open to the same objections that sodium chloride is. One fluid ounce per two gallons of wash water will deposit the whole of the silver as chloride in twenty-four hours, or in much less time if the operation is carried on in daylight. The solution will not become perfectly bright; when it is moderately clear, it may be drawn off so as not to disturb the sediment, after which more washing waters may be added, the same operation being repeated each day until a sufficient quantity of chloride has accumulated to warrant the trouble of reducing. The simplest plan of treating the chloride is to collect it on a filter (an old soft felt hat answers perfectly), and dry it in an oven. The substance will look more like mud than the beautiful white flocculent precipitate familiar to students of chemistry. It is now ready for the refiner, or may be put into the crucible with one-half its weight of a mixture of potassium and sodium carbonates, together with borax as previously described, and subjected to the furnace for the space of twenty to thirty minutes to obtain a button of pure metallic silver; or the dry chloride may be raised to

red heat, and when cool, a small quantity of dilute sulphuric acid (1-6) may be added. Cover the top with granulated zinc, and leave it for half an hour; at the end of that time the metallic silver will be found at the bottom. Wash well with hot hydrochloric acid and water, or boil for a few minutes, for the purpose of dissolving any fine particles of metallic zinc which may have become attached to the button of silver; then convert into silver nitrate crystals by means of strong nitric acid. There is another easy way of reducing silver solutions to the metallic state by means of bright strips of copper. After twenty-four hours' action the addition of salt will indicate the presence or absence of silver nitrate. Wash residue until the green tinge of copper no longer appears. Then heat in nitric acid to dissolve. Boil for a few minutes. When cold add silver oxide, or ammonia, to neutralise.

Gold.—Old toning baths should be kept separately when they are to be operated upon at home. The gold may be recovered by adding five ounces of a 20-grain solution of ferrous sulphate (sulphate of iron) per quart of waste solution. Gold will be deposited in the metallic state, and only requires washing on a filter with hot water until all traces of iron are washed away, which can be ascertained by testing the water for iron with barium chloride solution; pour on strong nitric acid, to dissolve any silver that may be present; finally, wash with hydrochloric acid, and dissolve in the usual solvent—nitro-hydrochloric acid—one part of nitric acid to three parts of hydrochloric. When the residues are to be sent to the refiner, all waste gold solutions may be added to the print washings, taking the precaution to add some ferrous sulphate after each addition. It does not inter-

fere with the recovery of the silver chloride; the refiner separates the gold from the silver, and allows the value for each.

Hypo.—The fixing bath usually contains enough silver to make it desirable to extract the same before throwing it away. Two methods are most frequently employed; one of these is to suspend sheets of zinc in a large tub or other vessel containing the old baths, leaving them until all the silver is deposited on the zinc; and the other is to add so-called liver of sulphur. A saturated solution of sulphuret of potassium should be poured into the old hypo-fixing baths, keeping the same as far away from the dwellings as possible, on account of the disagreeable smell of hydrogen sulphide evolved. Gold or silver residues of any kind may be added to the vessel containing the sulphuret. It will all go down as a sulphide, and may be forwarded to the refiner.

Although a series of tanks similar to that shown in the foregoing sketch is the best to recommend, circumstances may determine a different arrangement, in which case a cheap substitute may be found in empty paraffin oil casks, purchasable from most oilmen at five shillings a piece or thereabouts. These may be reared on end in a position suited to receive the liquids to be acted upon, and it is more convenient to insert a tap ten or twelve inches from the bottom to run off supernatant liquid, than resort to bailing out or the yphon.

CHAPTER XVIII.

DETERMINING THE PROPORTION OF SILVER IN SOLUTION.

Test for Silver.—A means of ascertaining the percentage of silver nitrate in the sensitizing bath is indispensable, and for rough estimations the floating glass bulb named an Argentometer, fig. 19, fulfils the condition tolerably well; at

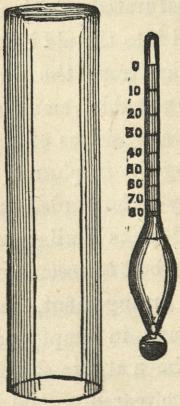

Fig. 19.

least the index register will be within a few grains per ounce of the actual strength. This instrument is graduated from zero (representing pure water at 60°F.) to 90°. The density of the liquid under examination will proportionately raise the scale above zero, and the figures indicated at fluid level show approximately the number of grains of silver nitrate per fluid ounce the solution contains. When a sensitizing bath has been active for some time it will have

gathered other nitrates from the paper, also albumen, and possibly other additions, which tend to increase the density of the liquid, so that the hydrometer method of testing, above referred, to, would not be sufficiently reliable for some purposes; but an assay may be made by double decomposition, which, if carefully done, will yield absolutely certain results.

Two modes are used by chemists in this country. One, a percentage solution of sodium chloride in water, and the other, an aqueous solution of sodium thiocyanate of decinormal strength. With either of these reagents the silver solution under treatment acts more satisfactorily when slightly acidified with nitric acid.

Procure two graduated tubes or burettes, and a suitable stand (see fig. 20). These may be obtained of any dealers

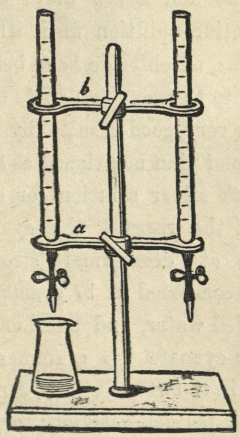

Fig. 20.

in chemical apparatus, graduated for grains or grammes; but there does not appear to be sufficient demand to induce

the manufacturers to graduate them for ounces and drachms; the calculation is not difficult, for when we consider 100 cubic centimetres represent 1,700 minims, no inconvenience is felt.

Those who employ sodium chloride should adopt Dr. Lagranges's table of strengths; it will be found on page 341, Vol. XXVI. PHOTOGRAPHIC NEWS.

The standard solution is as follows:—

Sodium chloride	1 part
Water	10 parts

Put this in one burette, and the silver to be tested in the other. Read off the fluid levels of each. Then run off one c.c. of silver into a beaker; dilute copiously with distilled water, and add a few drops of dilute nitric acid. Next deliver chloride solution until white p.p. is no longer given. If 5·7 c.c.s. of chloride have been used, there is one part of silver nitrate to every ten parts of water. Although the writer obtains very good results by the choride method, he prefers the second plan mentioned as follows:—

Make up a stock silver solution for standardizing, also a stock solution of the reagent thio-cyanate of ammonium (NH_4CNS), used at decinormal strength. Given two standard solutions composed of 17 grammes of silver nitrate per litre of distilled water, and another solution composed of ammonium thio-cyanate 7·6 grammes (dry crystals) per litre of water, we have two solutions capable, when mixed, of bringing about a perfect reaction; or, using volume for volume, they are of the same value. Acid solutions of silver may be tested, and the result of the determination shows no apparent difference than when they are tested

neutral. Potassium thio-cyanate (KCNS) 9·7 grammes dissolved in one litre of water has the same value as the foregoing solution.

Each c.c. of the re-agent is equal to ·017 grams of silver nitrate, or ·0108 of pure metallic silver; thus in testing we multiply the number of c.c.'s employed to act on each c.c. of the silver solution by that number of times ·017. An easy way to ascertain how many grains per fluid ounce are contained in a definite number of grains per litre, is to multiply by 70, and divide by 160; thus the decinormal solution of 17 grams of silver multiplied by 70 and divided by 160 equals $7\frac{7}{8}$ grains per ounce—practically $7\frac{1}{2}$ grains per ounce.

The practical application is as follows:—Fill one burette to the top gradation marked 0, with the sensitizing bath. Fill the second burette also to 0, with the reagent, which we will term "thio"; by means of a pipette, deliver a quantity equal to 5 cubic centimetres of the colour indicator (described in detail below) into a clean beaker; also a similar quantity of dilute nitric acid (1-5). Into this run the silver until the bead reaches 5. Add "thio" from the other burette cautiously, shaking gently after each addition, until the red colour disappears. More "thio" is now added, and the operation of gently shaking repeated. When the precipitate is no longer grey, but the liquid retains a pale reddish tinge, the re-action is complete. Note carefully how much has been used, because the number of cubic centimetres required to bring about the re-action will indicate the amount of silver present. As one cubic centimetre of the re-agent = ·017 of silver nitrate, or ·0108 of actual silver, therefore if 20 c.c.'s have been required, the sensitizing

solution is four times stronger than the standard silver, *i.e.*, each ounce would contain 30 grains of silver nitrate.

Although the metric system is undoubtedly the best, it does not follow that every one may care to adopt it. Those who prefer English weights in grains, having the same molecular value as the grammes above quoted, should make up the solution as follows :—

Standard Silver Solution.

Silver nitrate	... 262·353 grains
Distilled water	... 17,000 minims

Standard Thio-cyanate Solutions.

Ammonia thio-cyanate ...	... 117·289 grains
Distilled water	... 17,000 minims
Or,	
Potassium thio-cyanate...	... 149·693 grains
Distilled water	... 17,000 minims

The indicator used is ammonia ferric alum, ten per cent. solution, and its object is to obtain a decided colour the moment the reaction is complete. One drop of the silver solution is sufficient to destroy the colour, and a similar quantity of the reagent will cause it to return, hence the extreme accuracy of this method beyond all others.

Ammonia ferric alum is made as follows :—In an evaporating dish place 55 grammes of ferrous sulphate, 10 grammes of concentrated sulphuric acid, and 7 grammes of nitric acid sp. gr. 1·4; heat the mixture on a sand-bath, constantly stirring until it assumes a pastey consistency, and the red fumes, consisting of oxides of nitrogen, cease to be given off ;

remove from the sand-bath, and carefully add about 60 cub. cents. of dilute sulphuric acid (1 part of acid to 10 parts of water); warm until dissolved, then add 13 grammes of ammonium sulphate; when dissolved, filter the solution, and set aside to crystallize. The crystals, which separate out, have the following formulæ :—

$$(NH_4)_2SO_4Fe_2(SO_4)_2+24OH_2.$$

CHAPTER XIX.

PRESERVING SENSITIZED PAPER.

Of late, the employment of ready-sensitised paper has become more general than at any previous time since its introduction; photographers, both amateur and professional, being now bent on discovering the commercial sample which, with reasonable keeping qualities, will yield the most perfect result. Unfortunately, this is no easy matter, for although some brands are better than others, and they are numerous, not any appear to be equal to paper freshly sensitized on a neutral bath. The exact method of preparation is a trade secret, but nearly all the samples, when soaked in water, and tested with litmus paper, will show an indication of an acid; and the greater the proportion of acid, the longer will the paper keep. The most simple is the neutral method with sodic bicarb., published in the Photographic News in 1871 by J. C. Hopkins. The following instructions will be found sufficient:—Let the sensitising bath be neutral, and contain 50 grains of silver nitrate per fluid ounce, to which has been added a small lump of common alum. Float two minutes, and dry thoroughly, then pack between sheets of white blotting-paper which have previously been soaked in a seven or eight per cent. solution of bicarbonate of soda, and well dried. If carefully packed away in an air-tight case under

pressure, as in a printing frame, it will keep a long time. The sodic paper can be used over and over again, but must be dried each time. Paper thus preserved prints and tones well; but should the sensitising bath be acid, or the paper be packed damp, there is danger of mottled prints. G. Watmouth Webster, writing some time afterwards, says:—"I earnestly recommend every photographer, professional or amateur, to adopt the plan for two or three days only as an experience. I have not a doubt he will never relinquish it for the old system."

Some alkaline, neutral, and acid salts of non-hygroscopic properties, that do not reduce silver, may be applied to sensitized paper by floating or immersion, and confer keeping qualities: potassium nitrite and sodium sulphite are examples. Paper washed in pure water after sensitizing keeps much longer than it does when the uncombined silver nitrate is permitted to remain; but there is no possibility, even with fuming, to attain anything like the degree of richness in prints therefrom that is ordinarily desired.

Citric and tartaric acids are largely used for preserving sensitized paper. Some makers add the nostrum direct to the bath, so that the sensitizing and keeping qualities may be conferred at one and the same time. Should it transpire that the addition of either of these acids causes cloudiness of the solution, a few drops of nitric acid will render it again clear. An excess of this latter acid is apt to produce flat prints devoid of vigour. A workable formula is one that contains between forty and fifty grains of silver nitrate, and five of tartaric or citric acid per fluid ounce. The period of floating need not exceed three minutes in winter, and in summer even less will be sufficient.

Another plan of using these acids, whereby a similar result can be achieved, is that of sensitizing on a slightly acidified silver solution, about fifty grains of silver nitrate to the fluid ounce. Float as usual, then blot off and suspend until surface dry, then refloat the back of the paper—before it curls too much to become unmanageable—for thirty seconds on a solution of one of the above acids, or a mixture thereof, together with or without a colloid. One part of acid to fifteen parts of water answers.

The writer has preserved the whiteness of sensitized paper for more than a year by the following formulæ :—

Picked gum-arabic	3 ounces
Water	100 ,,

When dissolved, add

Citric acid...	2 ounces
Tartaric acid	2 ,,
Strong hydrochloric acid	2 ,,

After sensitising in the usual manner, and the paper is still damp, the back is floated on this mixture, and left for long or short intervals, according to the length of time the paper is required to keep. In the ordinary way thirty seconds to a minute will suffice ; but the sample alluded to, which was white after a year's storage, received five minutes' floating on the acid bath. The addition of gum is useful with any of the acids, its function being to obstruct the passage of air into the interior, and, being soluble, it is removed by the washing waters given to the print before toning. The annexed is extracted from Dr. Vogel's "Progress in Photography" :—

Willis' Permanent Sensitive Paper.—"A solution is made

of 462 grains of citric acid in 6,930 grains of distilled water. Albumenised paper is silvered as usual on a bath about 1 : 10, and hung up to dry. When surface dry, the edges are blotted off with paper, and the sheet again floated for about ten seconds *on the reverse side*, on the citric acid solution, and again hung up to dry. (The author, Dr. Vogel, finds it more convenient to lay the citric acid solution on with a brush.) If well dried, and kept in a perfectly dry place, it will be good at the end of two or three months."

W. E. Debenham has advocated the use of perchloric acid. That gentleman recommends ten drops of pure acid to be added to each fluid ounce of the sensitizer. The writer has preserved paper white for two weeks in this way, and the prints, in toning side by side with freshly prepared paper, were not one whit slower.

Papers treated with citric or analogous acids are, on the other hand, often difficult to tone unless more concentrated gold and alkali solution be used. This is due to the retarding action of the said acids remaining in the paper after the preliminary washings. Thus it has become the custom of those who employ acid papers to soak the prints therefrom, first of all in a dilute alkaline solution, such as ammonia or washing soda, preferably the latter; this converts free acid into either a citrate, tartrate, or other soluble salt, which passes out into the subsequent washing waters, always provided they are of sufficient duration; in fact, some printers recommend soaking the prints from acid paper half an hour before introducing them into the toning bath.

APPENDIX.

THE annexed toning baths comprise the more important formulæ used by silver printers in Europe and America.

Some will be found to confer a distinct characteristic colour, but it should always be remembered that conditions may vary in other respects to alter materially the result.

Both sensitized paper, and negatives printed, will play an important part in determining the final tone of the print.

No. 1.—*Alkaline Toning Bath.*

Sodium carb. ($Na_2 H Co_3$)... ...	5 grains
Gold terchloride ($Au Cl_3$)	1 grain
Water	10 ounces

No. 2.—*Hanaford's Acetate Bath.*

Sodium acetate	20 grains
,, chloride	10 ,,
Gold terchloride	1 grain
Water	10 ounces

Neutralize with chalk.

No. 3.—*Maxwell Lyte's Borate Bath.*

Sodium biborate (borax)	180 grains
Gold terchloride	5 ,,
Water	50 ounces

No. 4—*Ditto Phosphate Bath.*

Sodium phosphate...	300 grains
Gold terchloride	15 ,,
Water	35 ounces

No. 5.—*The Tungstate Bath.*

Sodium tungstate	300 grains
Gold terchloride	15 ,,
Boiling water	35 ounces

No. 6.—*The Citrate Bath, with Washing Soda.*

Stock A—Citric acid	1 ounce
Water	20 ounces
Stock B—Gold terchloride	15 grains
Water	15 ounces

Take one ounce of A, neutralize with washing soda, saturated solution. Take one ounce of B, neutralize with sodium carbonate, mix, dilute with ten ounces of water at 75° F., made slightly alkaline with sodium carbonate.

No. 7.—*Le Gray's Lime Bath.*

Lime chloride (saturated solution) ...	2 drops
Gold terchloride	2 grains
Chalk to neutralize	
Water	15 ounces

No. 8.—*The Uranium Bath.*

Stock A—Uranium nitrate	... ...	15 grains
Water	... ...	10 ounces
Stock B—Gold terchloride	... ...	10 grains
Water	... ...	10 ounces
Stock C—Sodium acetate	... ...	100 grains
Sodium chloride	... ...	100 ,,
Water	... ...	10 ounces

Neutralize one ounce each, A and B, with sodium carbonate, then add to C, warm to 75° F.; it is then ready for use. The uranium and gold salts may be used in above proportions with water instead of C, or a mixture of sodium tungstate and borax may replace sodium acetate and salt.

No. 9.—*The Hypo and Gold Bath.*

Sodium thiosulphate	2 ounces
Gold terchloride	5 grains
Water	10 ounces

No. 10.—*Watts' Platinum Bath.*

Platinum tetrachloride (syrupy solution) ...	60 minims
Sodium thiosulphate (hypo)	6 grains
Hydrochloric acid	10 minims
Water at 70° F.	10 ounces

Preparation of Gold Terchloride.

Take one ounce of metal (to be obtained at most banks), place in wide-mouth jar, pour on *aqua regia* mixed in the proportion of nitric acid one ounce, hydrochloric five ounces; heat moderately to effect solution, but not sufficient to drive off chlorine. After the lapse of an hour, pour off the deep

yellow liquid into a Winchester bottle, and add more *aqua regia* until the gold is all extracted. The solution may now be diluted with water sufficient to fill the Winchester, and in this condition will keep good for any reasonable length of time. The strength will be about one grain to each drachm of liquid, and before use will require neutralizing with sodium carbonate or chalk.

If it be desired to obtain greater purity, the gold must be precipitated with ferrous sulphate solution, washed by decantation, redissolved in *aqua regia*, and can then be crystallized; but this extra work is not at all necessary for toning purposes. It is illegal to dissolve coins of the realm; but if other coins are used, there will be about ten per cent. of copper in solution, which does no harm to the toning bath. Silver nitrate is not often made by photographers. The metal is freely soluble in excess of warm nitric acid, and is easily crystallizable therefrom.

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8½ ,, 6½ ,,	8 ,, 5 ,,	11 ,,	7 0 0
10 ,, 8 ,,	8½ ,, 6½ ,,	13 ,,	9 0 0
12 ,, 10 ,,	10 ,, 8 ,,	16 ,,	11 0 0
13 ,, 11 ,,	French size	17½ ,,	12 0 0
15 ,, 12 ,,	12 by 10 in.	19½ ,,	15 0 0
18 ,, 16 ,,	15 ,, 12 ,,	24 ,,	20 0 0
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2	15 ,, 12	7½ ,,	8½ ,,	10 10 0
3	18 ,, 16	11 ,,	13 ,,	14 0 0
4	22 ,, 20	14 ,,	15½ ,,	20 0 0
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3	10 ,, 8	10 ,,	5 10 0
4	12 ,, 10	12 ,,	7 0 0
5	15 ,, 12	15 ,,	8 10 0
5A	15 ,, 12	18 ,,	9 10 0
6	18 ,, 16	18 ,,	10 10 0
7	22 ,, 20	22 ,,	14 0 0
8	25 ,, 21	25 ,,	19 0 0

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4	12 ,, 10 ,,	2⅝ ,,	18 ,,	9 10 0
5	15 ,, 12 ,,	3 ,,	22 ,,	11 10 0
6	18 ,, 16 ,,	3½ ,,	25 ,,	14 0 0
7	22 ,, 20 ,,	4¼ ,,	30 ,,	17 10 0

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